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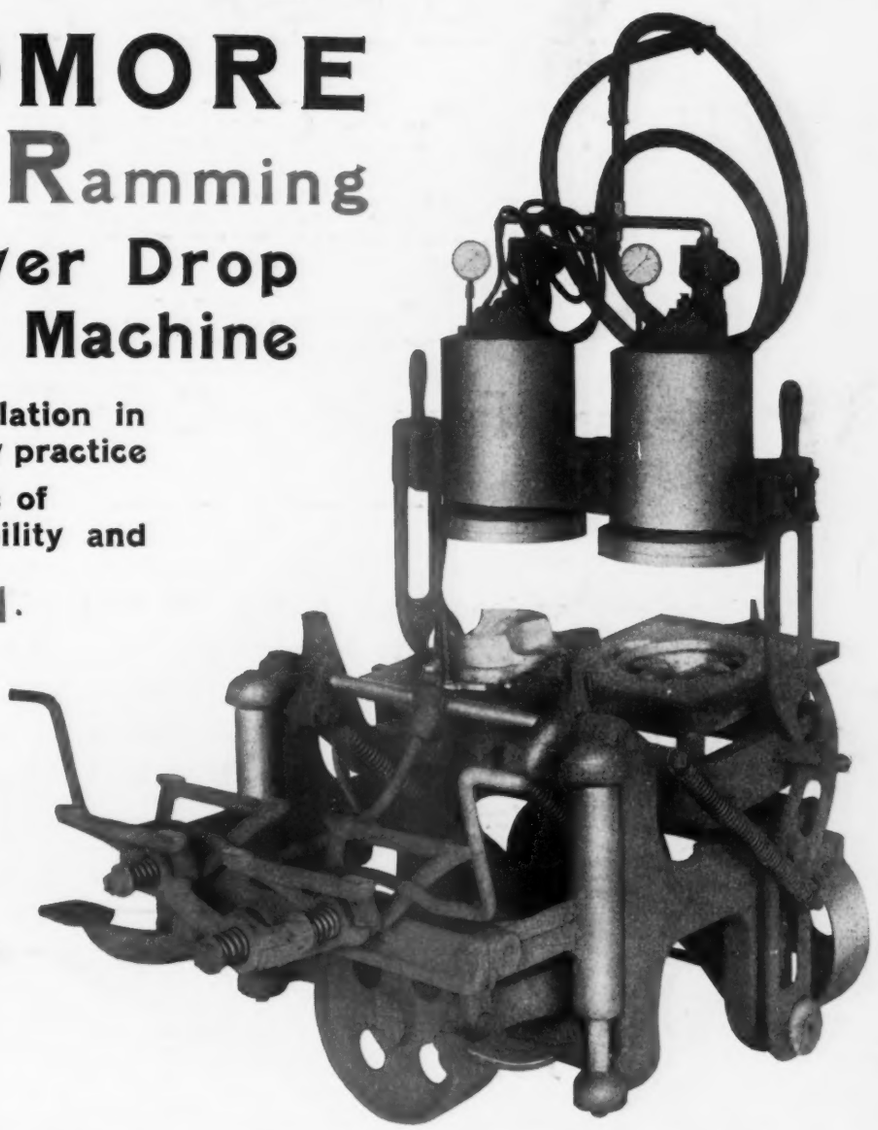

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THE FOUNDRY

Vol. 34, No. 3 CLEVELAND, OHIO, MAY, 1909 Whole No. 201

MOLDING AND CASTING 90-TON FRAMES

How large engine beds for gas engines are made by the Allis-Chalmers Co., including the setting of the cores, drying the molds and handling the castings

AT Gary, Ind., the United States Steel Corporation has under construction the largest steel plant in the world, which is of such stupendous proportions that it cannot properly be compared with any previous industrial undertaking. A more desolate site than the sand hills of northern Indiana, bereft of even the most scraggy vegetation, could hardly have been chosen. Yet, within a period of only a few years, it has been transformed into a model industrial center, blast furnaces, steel works and rolling mills erected, and a town has been laid out and built up for the accommodation of the thousands of employes of this great plant. In the erection of these works obstacles, which at first appeared insurmountable, had to be overcome. A stream which flowed through the property and interfered with the general layout was turned from its course and the main line tracks of several railroads had to be diverted from their original route to permit of the present arrangement of the various departments.

The equipment, including the mills, gas and blowing engines, electrical

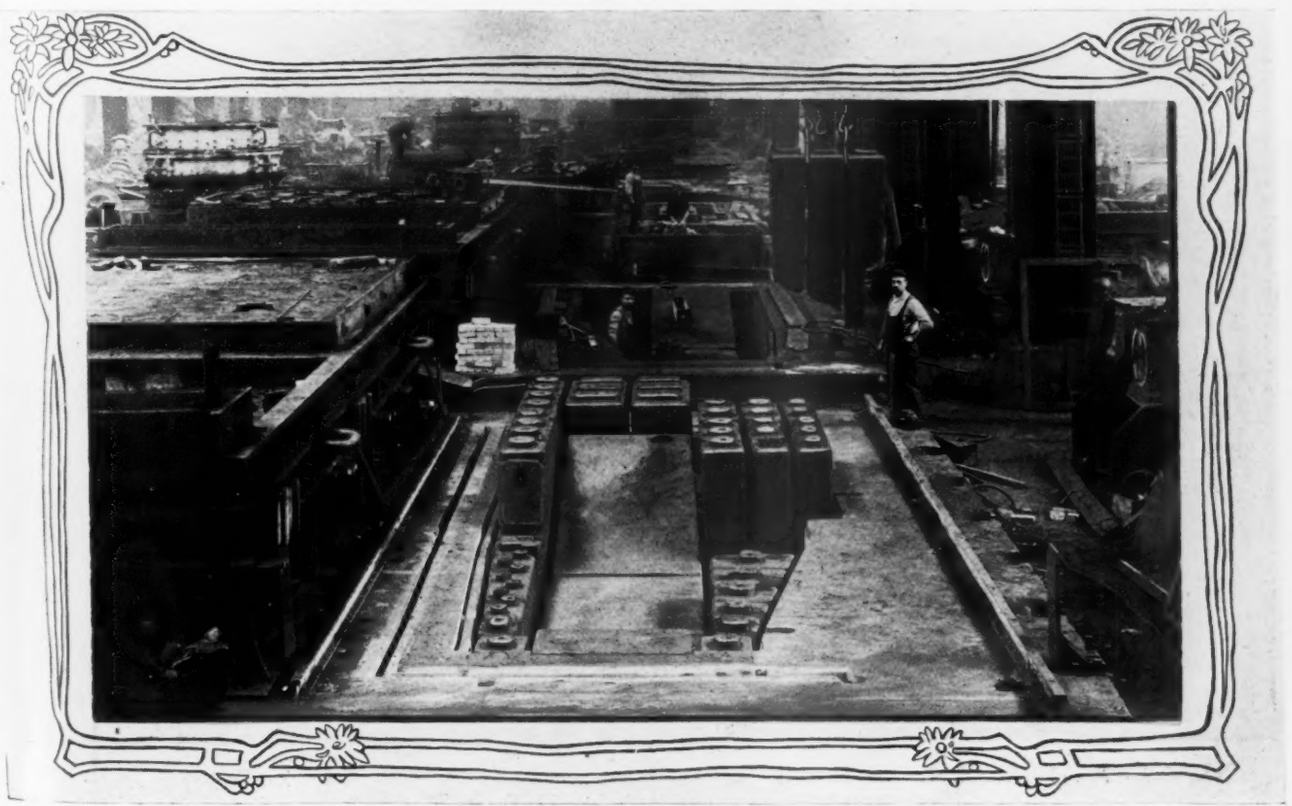


FIG. 1—SETTING THE CORES IN THE LARGE ENGINE FRAME MOLD

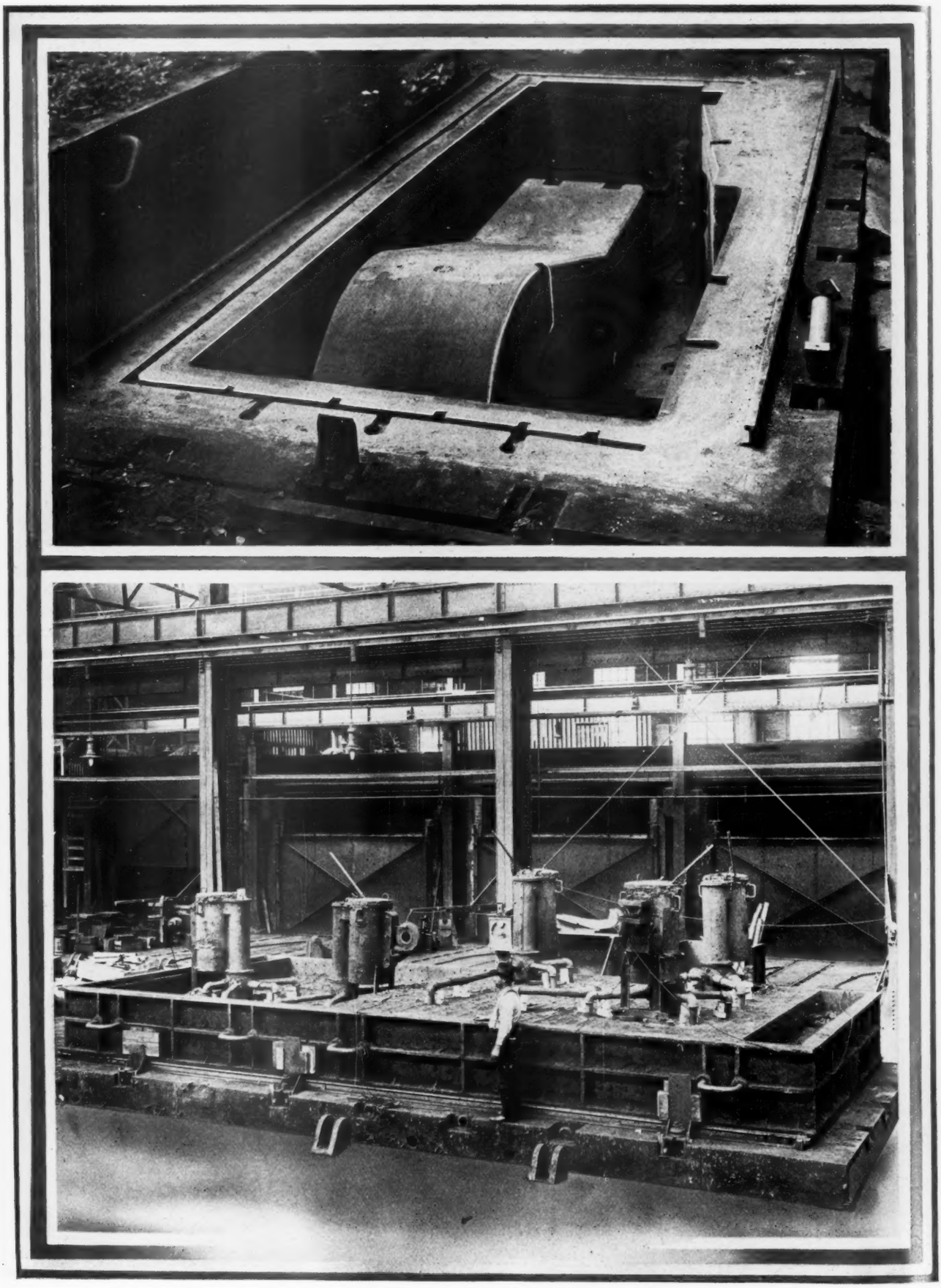


FIG. 2—DRAG HALF OF THE LARGE ENGINE FRAME MOLD WITHOUT THE CORES IN POSITION
FIG. 3—DRYING THE LARGE ENGINE FRAME MOLD

machinery, etc., measures up to the general proportions of the plant, and its manufacture was marked by many notable engineering accomplishments. The Allis-Chalmers Co., Milwaukee, was awarded the contract for the gas engine installation, comprising 25 units of 4,000 horsepower capacity each. Considering the size of the engines and the many problems involved in their construction it was a great undertaking. The engines have a cylinder diameter of 44 inches by a 54-inch stroke, and weigh approximately 1,500,000 pounds. The fly wheels are 23 feet in diameter and weigh from 150,000 to 200,000 pounds, according to service. The engine frames, machined, weigh 180,000 pounds each, and other large castings for these engines include the cylinders, 6,000 pounds, distance pieces, 42,000 pounds, and tail guides, 16,000 pounds.

Difficulties Involved.

The molding and casting of these large sections, together with their subsequent machining, involved many difficulties, especially in handling as well as their transfer from one department to another, yet the model arrangement of the West Allis plant, where this work was done, together with its adequate equipment for the production of large castings, converted this undertaking into an almost daily routine task, not only for the foundry but the machine and assembling shops as well.

Adequate Equipment.

In the foundry no additional rigging, cranes, pits, nor other equipment was required to produce these large castings with economy and dispatch. In the middle bay of the shop there are no less than 14 large molding pits, as well as one large casting pit, while the capacity of the cranes in this section insured the handling of the castings with ease, and the five cupolas provided sufficient metal for even the largest frames in a very short time. It was due to this magnificent equipment and the well trained working force that the phenomenal record of one engine frame casting per week was possible until the order of the Indiana Steel Co. was filled. Including the molding and cooling, about four weeks elapsed before an engine frame casting was removed from the pit. While this order was going through the shop four pits were constantly in use. Including the molders and helpers, it required about 950 hours to complete each mold. This record is undoubtedly without parallel in foundry practice and reflects the completeness of the arrangements for doing this work.

Large Pits.

The four pits in which these castings were molded are each 40 feet long, 15 feet wide and 11 feet deep. They are built of concrete, the walls being 30 inches wide at the bottom tapering to 18 inches at the top. For binding the molds, eye-bolts, extending through the walls, anchored at the bottom, are provided. These are spaced 3 feet apart, 12 on each side and three on the ends. These bolts are clearly shown in Figs. 1, 2 and 3. For holding down cores, eye-bolts are also imbedded in the bottoms of the pits, being spaced 2 feet apart. A full pattern made in two sections to facilitate handling was used for the frames. It has an over all length of 26 feet 6¼ inches, is 10 feet 11 inches wide and 10 feet 8 inches at its highest point.

Making the Mold.

The drag of the mold before the cores are set is shown in Fig. 2, and in Fig. 1 practically all of the lightening cores are in place, three being shown suspended from a crane, held together with bars. Chaplets are used

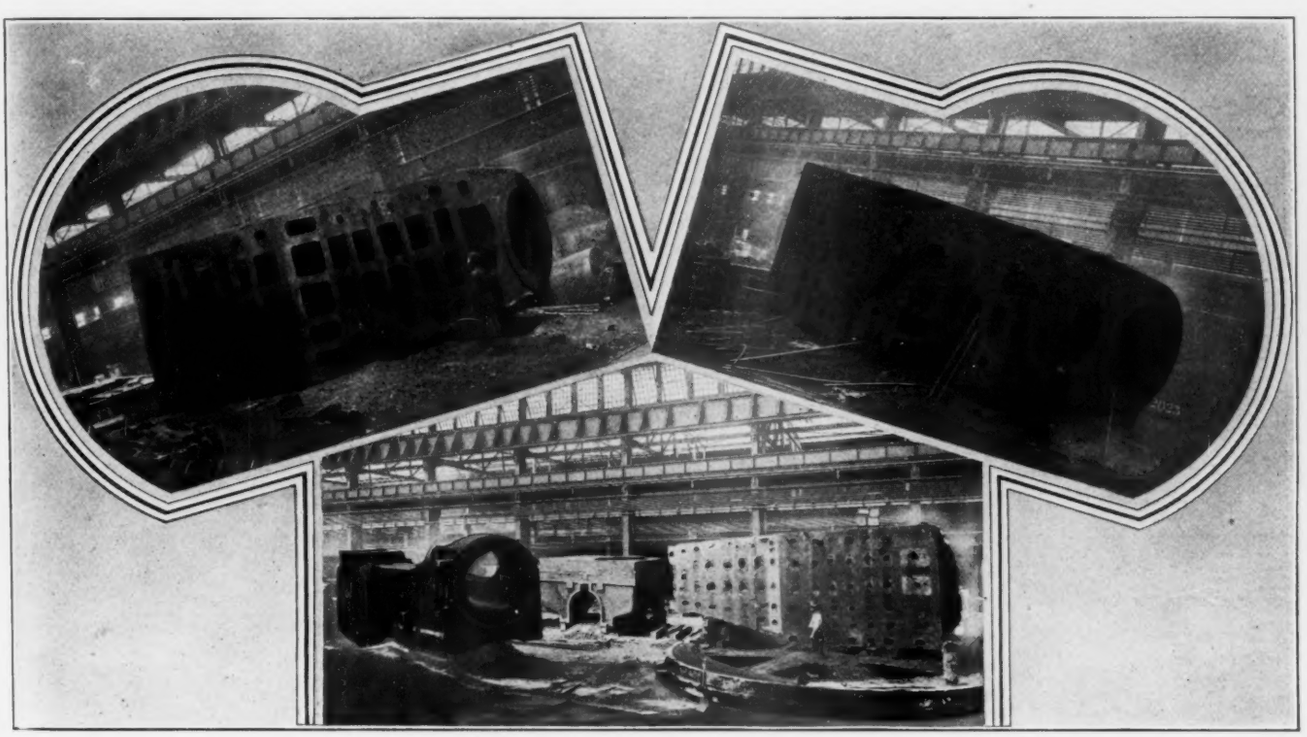


FIG. 5—THE CLEANED ENGINE FRAME CASTING

FIG. 4—ENGINE FRAME CASTING BEFORE THE CORES HAVE BEEN REMOVED

FIG. 6—VIEW IN THE FOUNDRY OF THE ALLIS-CHALMERS CO., SHOWING TWO LARGE ENGINE FRAMES AND A LARGE FLY WHEEL

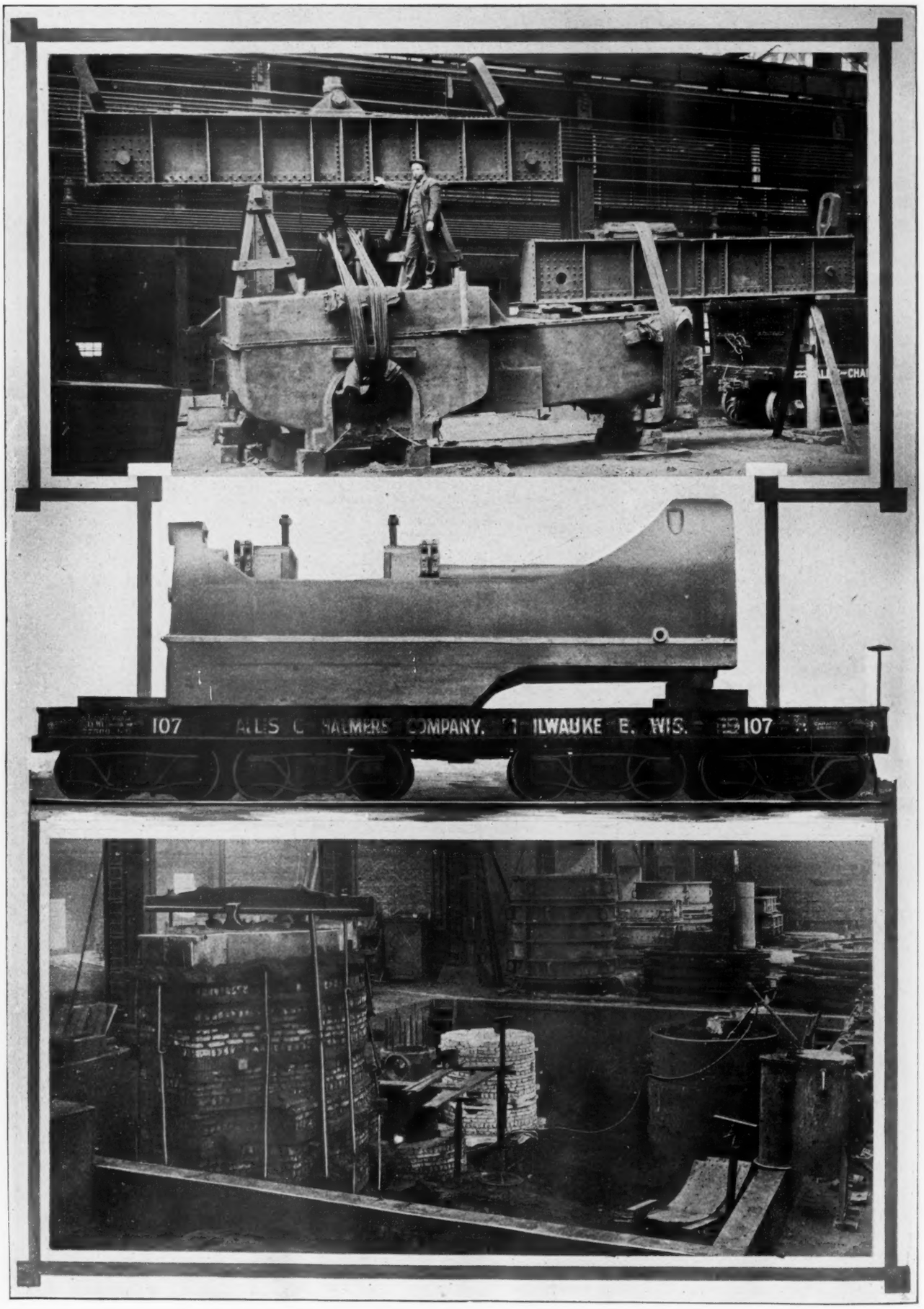


FIG. 7—RIGGING FOR HANDLING LARGE ENGINE FRAMES IN THE FOUNDRY
FIG. 8—LARGE ENGINE FRAME READY FOR SHIPMENT, A 200,000-POUND FLAT CAR BEING USED
FIG. 9—THE LARGE CASTING PIT

in this section of the mold for supporting the cores, but the cores for the water space section of the frame, which must withstand a high pressure, are hung in the cope, no chaplets being used. The cope flask is made in two sections and only a portion of the pillow block is in this part of the mold. The method of drying one of these molds is shown in Fig. 3. Approximately 72 hours is required, five dryers being used. These are coke fired and an electrically driven fan at the side forces the air either through or over the fire, as desired, into a chamber to which numerous pipes are connected that lead to the various parts of the mold. This device was described in more detail in the January, 1909, issue of THE FOUNDRY. The mold is secured with cast iron beams fastened to the eye-bolts in the walls of the pit, thereby doing away with all weighting down of the mold. This practice is followed throughout the shop and no castings are lost from this source of difficulty.

Pouring the Engine Frame.

Approximately six minutes are required to pour the metal into one of these molds, five ladles being used, two of 25-tons capacity, two of 30-tons capacity, and one of 10-tons capacity which provides the metal for the feeder located over the pillow block. The metal is poured into a continuous runner extending around the mold provided with numerous gates so as to get the metal into the mold as speedily as possible. To accumulate this amount of metal the iron must be held about 2½ hours, and being covered with charcoal there is no perceptible loss of temperature. Owing to the great mass of metal, the casting is permitted to remain in the sand about two weeks for cooling. The continuous runner, in a measure, acts as a mixer, insuring a uniform grade of iron from the various cupolas from which it is tapped. Five cranes are used for handling the ladles which are of the lip-pour type. The casting varies in thickness from 2 to 3 inches, and despite the liberal use of cores in the base, weighs about 95 tons before being machined.

Rigging for Handling the Frames.

To remove the casting from the pit three cranes of a combined capacity of 180 tons are used, inasmuch as it is estimated that, together with the cores, the casting, before it is cleaned, weighs about 170 tons. The rigging shown in Fig. 7 is employed to insure a steady lift and to prevent the swaying of the casting. At one end of the frame an equalizer beam is attached, as shown, wire rope being preferred to chains for safety. Another beam is tied to the casting at the other end, and by this arrangement an absolutely uniform lift is insured.

Cleaning.

The base side of one of these castings before it is cleaned is shown in Fig. 4, and in Fig. 5 all of the cores have been removed. In Fig. 6, two of these large castings are shown, as well as a tail guide and a 22-foot fly wheel. To transfer these castings to the machine shop, as well as for their delivery to Gary, Ind., especially built flat cars of 200,000 pounds capacity, provided with four trucks, had to be used. One of the frames loaded on one of these cars, ready for shipment, is shown in Fig. 8.

FIG. 10—CUPOLA SKIP PITS SHOWING PANS ON THE CARS FILLED WITH THE IRON AND COKE CHARGES

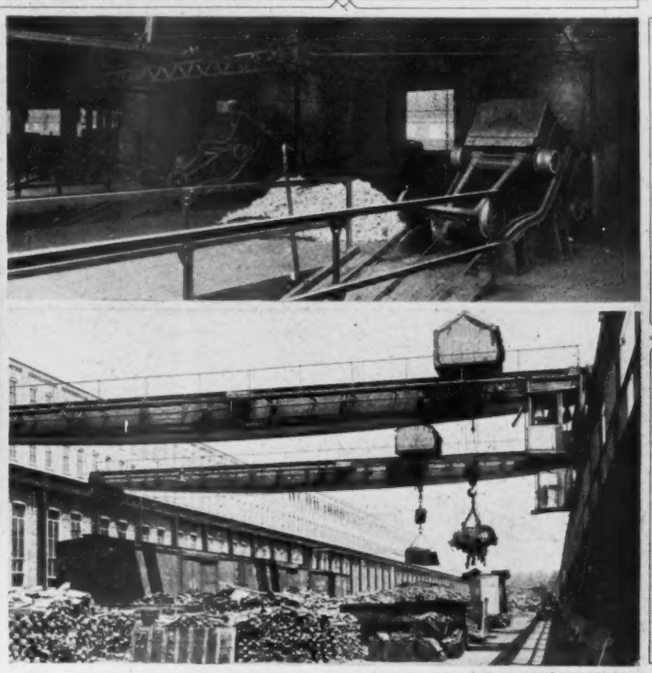


FIG. 11—SKIP CARS DUMPING CHARGES INTO THE CUPOLA
FIG. 12—THE IRON AND COKE STORAGE YARD

The large casting pit in which most of the large molds, cast on end, are poured, is shown in Fig. 9. It is 40 feet square and 12 feet deep and has proved an almost indispensable adjunct to the foundry. It obviates the necessity of raising ladles to a dangerous height to pour many of these molds, notwithstanding the liberal head room provided in this building. In the foreground is shown one of the cylinder molds of a cylinder for one of these large gas engines, which weighs 30 tons. The curbing has just been removed preparatory to shaking out the casting and the method of binding the mold can clearly be seen.

Three other molds are being rammed and built-up, and by the use of a pit of this kind the rigging, brick-work, etc., when removed from a mold, is confined to the pit and does not litter the rest of the shop as would otherwise be the case.

During the past year the Allis-Chalmers Co. filled orders for 40 of these large gas engines, having a capacity of 4,000 horsepower each, and in the foundry not one of these large engine frames was lost.

Interesting Features of the Plant.

The shop abounds in novel labor-saving equipment, the skip hoists which carry the material to the charging floor and deposit the charges into the cupolas being among the interesting features. The skip pits in the yard with the pans filled with pig iron and coke are shown in Fig. 10, and in Fig. 11 the charges are being dumped into the cupolas. The pans are filled in various parts of the yard with iron and scrap and are weighed by a scale attached to an overhead crane which conveys the charges to the skip cars. For handling the coke pans, a revolving jib crane is used, as shown in Fig. 9, the coke bins being located within the radius of this crane. The pans are held in position on the cars by a fork which engages a trunnion on each side of the pans. The cars are elevated to the large platform over inclined tracks by hydraulic power, and as shown in Fig. 10, the pans are dumped by elevating the rear end of the car which is provided with wheels wider than those on the front axle, and while the front wheels remain on an extension of the incline track, the rear wheels ride up on the outside track. To hold the car in this position, supporting rods, attached to sleeves which rotate on the rear axle are used, connecting with another pair of wheels that operate on the incline track.

Storage Yard.

The scrap and pig iron storage yard, Fig. 12, is always kept in an orderly condition, the iron being carefully piled according to grades, while the scrap, which is immediately broken after being received, is kept in bins. The entire yard is commanded by overhead cranes and an electric magnet is used for unloading the pig iron and scrap from the cars.

Sand and other supplies are received over an elevated track on the west side of the foundry, the sand being shoveled into bins inside the shop where it is stored and is, therefore, always in a suitable condition for use. Two sand mixing machines, one for facing sand and the other for the core mixtures, are located on a mezzanine floor. One of the continuous sand grinding machines, installed by the Standard Sand & Machine Co., Cleveland, is shown in Fig. 14.

One of the nine electric traveling jib cranes which commands the smaller pits, is shown in Fig. 13. By their use the larger cranes which span the shop have been materially relieved of much work, and the making of the molds is greatly facilitated.

"A place for everything and everything in its place" is the slogan which applies not only to the foundry but to all other departments of this immense plant. Notwithstanding the fact that the foundry partakes of the nature of a jobbing shop, owing to the large amount of miscellaneous work done, the floors are constantly maintained in an orderly condition and the gangways are always kept open. A special force of men is employed for this purpose and pits are distributed about the shop and yards containing buckets into which the refuse is dumped. One of these pits is shown at the left, Fig. 15, while at the right is illustrated the slag bucket in a pit, and the slag buggy, from an adjoining cupola room is shown dumping its load. When filled, the buckets are lifted out of the pits by an overhead crane and the refuse and slag are dumped into cars or used for filling, as desired.

With few exceptions, the molders in the foundry have secured their training in this shop. The apprenticeship extends over a period of two, three or four years, depending upon the facility with which the apprentice masters the art of molding. Apprentices, ranging in ages from 20 to 25 years are preferred to younger men

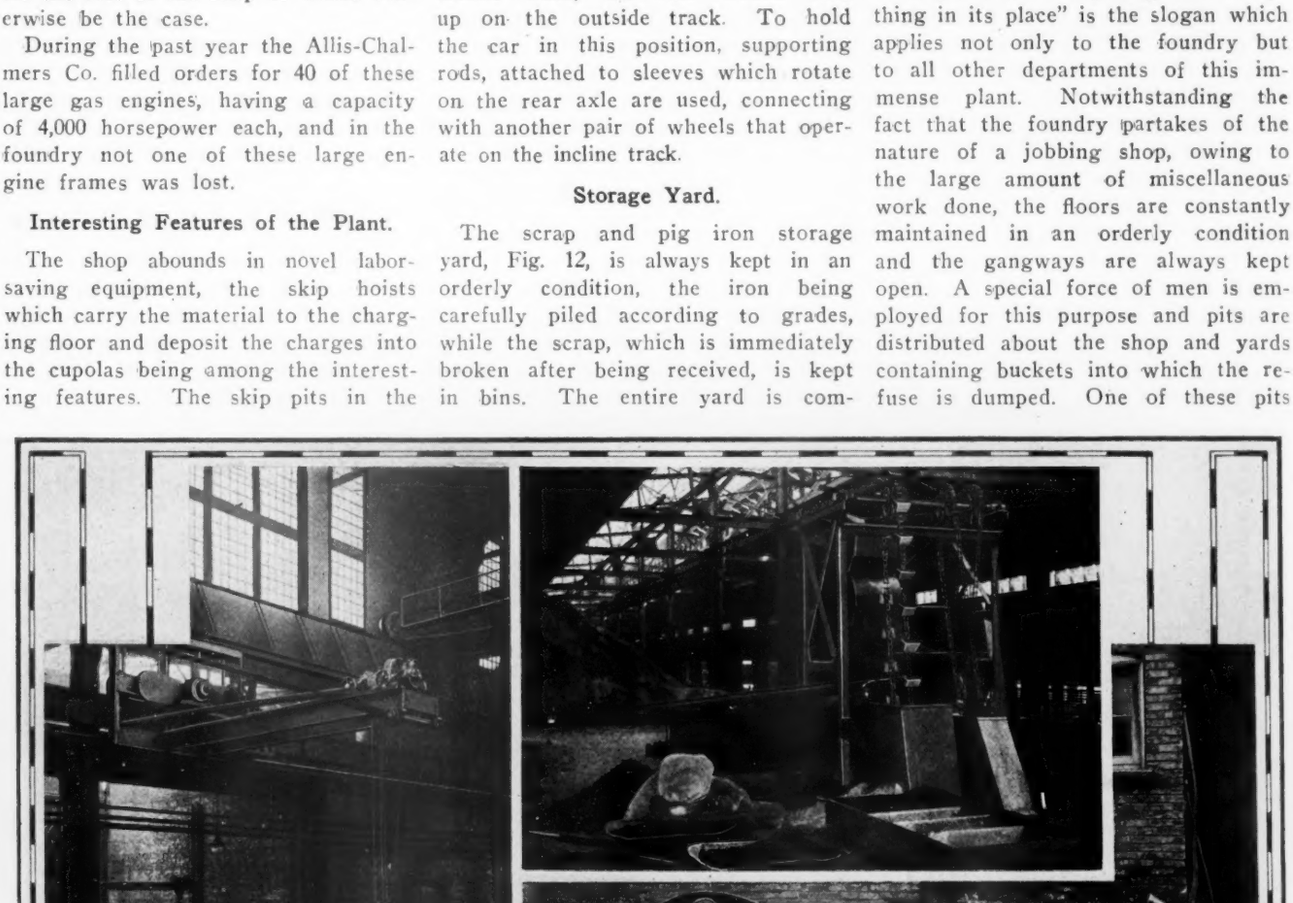


FIG. 13—ONE OF THE MANY TRAVELING JIB CRANES IN THE ALLIS-CHALMERS FOUNDRY

FIG. 14—ONE OF THE SAND MIXING MACHINES

FIG. 15—PITS AND BUCKETS FOR THE DISPOSAL OF SLAG AND REFUSE

as they apply themselves more diligently and progress more rapidly.

Many of the small as well as some of the larger patterns are being mounted on molding machines, and this equipment, which is gradually being increased, now includes two large, Herman jarring machines, Pridmore and Tabor roll-over machines, Pridmore stripping plate, and Arcade molding machines.

While the large Gary gas engine order was going through the shop, in addition to the routine work and the large engine frames, twenty 44 x 54-inch water-jacketed gas engine cylinders, weighing 30 tons each, were produced each month.

STANDARD PIG IRON SPECIFICATIONS.

At the April meeting of the Philadelphia Foundrymen's Association, Walter Wood, chairman of the committee on pig iron specifications, reported that an extended conference had been held between members of the committee, a sub-committee of the American Foundrymen's Association, represented by Henry A. Carpenter, Stanley G. Flagg Jr. and Herbert E. Field, and a sub-committee of producers representing the American Society for Testing Materials, composed of Noah H. Swayne 2d, Edgar B. Cook and E. F. Eldridge. A number of important suggestions were made and the following report presented:

It is recommended that foundry pig iron be bought by analysis, and that when so bought these standard specifications be used.

Sampling and Analysis.

Each carload, or its equivalent, shall be considered as a unit in sampling.

One pig of machine cast, or one-half pig of sand cast, iron shall be taken to every four tons in the car, and shall be selected from different parts of the car.

Drillings shall be taken so as to fairly represent the composition of the pig as cast.

An equal weight of the drillings from each pig shall be thoroughly mixed to make up the sample for analysis.

In case of dispute, the sample and analysis shall be made by an independent chemist, mutually agreed upon, if practicable at the time the contract is made.

It is recommended that the standard methods of the American Foundrymen's Association be used for analysis, Gravimetric methods shall be used for sulphur analysis, unless otherwise specified in the contract.

The cost of resampling and reanalysis shall be borne by the party in error.

In order that there may be uniformity in quotations, the following percentages and variations shall be used. (These specifications do not advise that all five elements be specified in all contracts for pig iron, but do recommend that when these elements are specified the following percentages be used.)

Allowances.

In case the furnace cannot for any good reason deliver the iron as specified at the time delivery is due, the purchaser may at his option accept any other analysis which the furnace can deliver; the price to be determined by the base table above, which must be filled out at the time the contract is made.

Silicon. 0.25 allowed either way. Per cent Code.	Sulphur. Maximum. Per cent Code.	Total Carbon. Minimum. Per cent Code.	Phosphorus. 0.150 allowed either way. Per cent Code.	Manganese. 0.20 allowed either way. Per cent Code.
1.00.....La.	0.04.....Sa.	3.00.....Ca.	0.20.....Pa.	0.20.....Ma.
1.25.....LaX.	0.05.....Se.	3.20.....Ce.	0.40.....Pe.	0.40.....Me.
1.50.....Le.	0.06.....Si.	3.40.....Ci.	0.60.....Pi.	0.60.....Mi.
1.75.....LeX.	0.07.....So.	3.60.....Co.	0.80.....Po.	0.80.....Mo.
2.00.....Li.	0.08.....Su.	3.80.....Cu.	1.00.....Pu.	1.00.....Mu.
2.25.....LiX.	0.09.....Sy.		1.25.....Py.	1.25.....My.
2.50.....Lo.	0.10.....Sh.		1.50.....Ph.	1.50.....Mh.
2.75.....Lox.				
3.00.....Lu.				
3.25.....Lux.				

In case of phosphorus and manganese, the percentages may be used as maximum or minimum figures, but unless so specified they will be considered to include the variation above given.

Base or Quoting Price.

For market quotations an iron 2 per cent in silicon (with variation of 0.25 either way) and sulphur 0.05 (maximum) shall be taken as the base.

The following table may be filled out, and may become a part of the contract. "B," or base, represents the price agreed upon for a pig iron running 2 in silicon (with allowed variations of 0.25 either way) and under 0.05 sulphur. "C" is a constant differential to be determined at the time the contract is made. (It is recommended that "C" be 25 cents per ton.)

	Silicon.					
Sulphur	3.50	3.00	2.50	2.00	1.50	1.00
0.03.....	B + 5 C	B + 4 C	B + 3 C	B + 2 C	B + C	B
0.04.....	B + 4 C	B + 3 C	B + 2 C	B + 2	B	B — C
0.05.....	B + 3 C	B + 2 C	B + C	B	B — C	B — 2 C
0.06.....	B + 2 C	B + C	B	B — C	B — 2 C	B — 3 C
0.07.....	B + C	B	B — C	B — 2 C	B — 3 C	B — 4 C
0.08.....	B	B — C	B — 2 C	B — 3 C	B — 4 C	B — 5 C
0.09.....	B — C	B — 2 C	B — 3 C	B — 4 C	B — 5 C	B — 6 C
0.10.....	B — 2 C	B — 3 C	B — 4 C	B — 5 C	B — 6 C	B — 7 C

This table is to be used for settling any difference which may arise in filling a contract, as explained under Penalties and Allowances, and may be used to regulate the price of a grade of pig iron which the purchaser desires, and seller agrees to substitute for the one originally specified. Silicon percentages allow 0.25 variation either way. Sulphur percentages are maximum.

Penalties.

In case the iron, when delivered, does not conform to the specifications, the buyer shall have the option of either refusing the iron or accepting it on the basis shown in the above table, which must be filled out at the time the contract is made.

TITANIUM ALLOY IN CAR WHEELS.

In a paper recently read before the Railway Club of Pittsburg, by Chas. V. Slocum, the use of titanium alloy in chilled iron car wheels was recommended. He stated that the addition of 1 per cent of titanium alloy has the effect of making the metal closer grained, it is free from blow holes and the wheels are stronger in the flanges, rims, plates, etc. The chemical change includes a reduction in combined carbon of about 0.50 per cent and an increase of the graphitic carbon of the same amount. This change reduces the chill somewhat, but improves its wearing qualities. The metal being freer from impurities heats less under the application of the brakes and, therefore, has less expansion and contraction strains. The use of this alloy in car wheels increases the cost from 75 cents to $2 per wheel, including the manufacturers' labor and profit. It has also been found that ingot molds containing less than 1 per cent of titanium alloy, when in use after dusk, could be picked out immediately from all the other molds in service. Those not containing the titanium alloy became red hot from the molten steel, while the two treated molds remained almost black. An iron containing titanium alloy has a low percentage of heat absorption, and consequently there is less expansion and contraction.

THE MODERN PATTERN SHOP LAYOUT*

The up-to-date arrangement of this department together with its equipment is discussed in detail

BY A. N. SPENCER

PATTERNMAKING as a distinct craft has existed but a few years, though patterns have been made for centuries. In olden times, the man who could best produce the pattern was given this duty to perform. He may have been a cabinet maker, a carpenter, or any other ingenious craftsman who could skillfully wield the rough tools of the period. Since the middle of the last century, patternmaking has been accepted as an art or a craft of such importance as to be divorced from the other trades. Patternmaking, having class and distinction, was placed where it belongs in the line of mechanical trades, near the head, and it is one line of wood manufactu ing where the innovation of machinery has not lessened the demand for the patternmaker with brains and originality, and as an aid to his fertility of brain, we have been brought to face the problem of his shop environment.

Location of the Shop.

For many years, the pattern shop cut no figure at all in the planning of work shops. It mattered not to the owner where this department was located as long as he did not have to look at it very much. It never was a money producer, so it lacked the essential quality to give it commercial value in his mind, and anything was good enough for the patternmaker.

Up to a period within the years that one may count upon the fingers, it was a common practice among owners of machine shops to exercise the utmost care in selecting the machine shop location, its light, its ventilation and its iron or metal working tools, and after this was completely cared for, and the question of patternmaking came up, it was a case of—"Oh! Haven't you some corner you can poke it into? Utilize the attic. Put it in the basement and don't use any more equipment than you actually have to. Get along with the cheapest tools you can find, any old thing is good enough to cut wood. It is easy to cut. Haven't you some part of the shop that you cannot use for anything else? Put the pattern shop there. We have to put so much money into the patternmaker's wages, we can't afford to do anything more for him."

New Era for the Pattern Shop.

This sort of thing is rapidly being consigned to the realms of recollection and the new order is to give the pattern shop its rightful place in the works.

What is to be considered its rightful place? Wherever there is plenty of good wholesome ventilation an abundance of light, and plenty of room. Put it next to the drafting department if you can. No one is more intimately associated with the designer than the patternmaker.

We acknowledge that the draftsman requires fine light. The patternmaker needs the same light, since he must read the drawings and work to them. He needs good air for the same reason that you and I need it. No chances for argument there. It would be unnatural to concede the desirability of correct ventilation in the work shop.

If you run your own foundry, let the pattern shop be next door, so the foundry boss can be neighborly. The designer and the patternmaker both need him if he is next to his job.

I might describe the unattractive, small shops I have seen and visited, the underground places, these top story and attic rooms in old ready-to-tumble buildings, where the patternmaker and his helper eke out a scanty existence in job patternmaking, but I feel there would be nothing gained by it. Fortunately such places are gradually dwindling in number.

An Extreme Case.

I well remember one extreme case. I was called to Chicago to sell a man a bill of machinery. I was directed to a place on the West Side that I found was one of a row of small tenements. With some misgivings I knocked at the door and was admitted by the man's wife and shown into a living room and sleeping room combined, with the request that I wait a few minutes and the patternmaker would be in. When he came in he took me into his shop which was his wife's kitchen, that actually was not over 8 feet wide and 12 feet long. In it were a corner sink, a small range, one chair with a small baby in it, and a table that did double duty, for dining and a work bench. To this table was secured a bench vise, and in it was a piece of wood being shaped for a fairly good-sized pattern, which he was making for a large concern in Milwaukee. He stated that he had made a good many patterns for this company, for which he was paid well, and he was thinking of installing an outfit of machinery, electrically driven, in his own cellar, a room about 18 feet square, with one-half window about 6 feet from the floor.

The question might be asked, what my personal ideas are, or what I would develop in the way of the pattern shop if called upon to erect one. To determine just what I would recommend, I must know in some measure what the work is to be, how varied in character and how many patternmakers would be employed.

Model Layout.

I believe that the ideal pattern shop should be located in a one-story building with a space of at least 20 feet between the floor and the roof timbers. I believe in supporting it in such a way with truss rods that will avoid columns or other supports that might be in the way on occasions. The building should be long and narrow, thus avoiding the necessity of sky-lights. I have already expressed my views as to light and ventilation. My pattern shop would have light on four sides if possible.

*Presented at the March meeting of the Detroit Foundrymen's Association.

The shop foreman's office should be in the center of the room next to the wall, so that he may readily have an unobstructed view of the whole plant. The lavatory and coat room should be placed in the open as far as possible. There should be plenty of light and ventilation, and perfect cleanliness in these departments.

I believe in the finishing of patterns being made a distinct department, and not troubling the regular patternmakers with that class of work that can be just as well accomplished by young men trained for the service. This is in the line of economy.

The modern pattern shop which we recently designed is 150 feet long, north and south, and 76 feet long, east and west. The building is reinforced concrete and well lighted by windows on all four sides.

Arrangement of Equipment.

The layout of the equipment is intended to save time for the patternmakers. The south end is taken up with racks for lumber, the superintendent's office and machinery for working the rough lumber, a swing saw, a universal saw bench, a jointer and a surfacer. The 40 patternmakers' benches are placed in groups of two, back to back, along the east, north and south walls, with a distance of about 9 feet between the groups. On the top of each set of benches are placed two-gallon, electric glue heaters and a bench trimmer. In a line about 5 feet from the inside ends of the benches are interspread, within easy walking distance of the workmen, five large universal trimmers, five small bench hand jointers, and four surface tables, all of which may be constantly used by the men.

Tools.

Still further away from the walls are alternately placed three band saws and two saw benches which are easily reached by all the patternmakers. Then the innermost part of the shop is taken up, in a line from north to south, by a 10-gallon glue heater, a 20-inch jointer, a boring machine, a grindstone, two tool grinders, a belt sander, a large face plate lathe, a 20-inch swing and a 30-inch swing patternmaker's lathe, a hand power dowel machine, a Wadkin universal woodworker and another belt sander.

All of the machines are driven by individual motors, and are so placed as not to be in each other's way. The entire arrangement leaves a large vacant space about 40 by 15 feet at the north end of the shop, and a space about 20 feet square, and one 16 feet square near the middle of the shop. Upon these spaces any large work may be built up.

Cost of Equipment.

As far as we know, this plan represents a better equipped shop than any now in existence, but harken to these figures: Benches, machines, motors and all cost about $16,000.

Against this investment are chargeable the following: Interest on the investment, 6 per cent; insurance, 2 per cent; depreciation, 5 per cent; power and maintenance, 10 per cent—23 per cent of 16,000, which means that each year, the extra expense incurred by the full equipment is $3,680—to be still more generous, say $4,000.

Saving Effected.

Now let us see about the saving incurred by such a full equipment. We believe that a modern equipment like we recommend above, as compared with the ordinary equipment that exists in many pattern shops today, will save at least 25 per cent on the cost of patterns. Assume that the cost of patterns consists of only the time of the patternmaker. Then our saving would consist of 25 per cent of the wages of the patternmaker. Say you pay your patternmakers only $16 per week. This means $33,280 annually for 40 men, for which this shop is designed. Twenty-five per cent of this pay roll means a gross saving of $8,320 a year. Deduct from this $4,000, which is the greatest possible annual expense incurred by this equipment as above shown, and you will have a net saving of $4,320 every year. Can you afford to be without it?

Small Tools and Conveniences.

There are many small tools and conveniences that can be used to advantage in a modern pattern shop which might prove interesting. I refer to the various quick-acting vises for work benches; the various surface tables, several of which have merit; the portable column racks, the rack for leather and wood fillet, wood dowels, etc.; the devices for keeping track of the time and of the cost of patterns, the cases for pattern letters, brass dowels, screws, brads, etc.

These devices all have merit because they add to the element of cleanliness about the pattern shop. They keep these small things in their proper order. In many pattern shops that I have visited, pattern letters of all shapes and sizes are placed in little boxes that are lined up, perhaps on the window sill or along the bench, and when a set of pattern letters is selected about 10 times as many minutes are consumed in finding them as should be. Having no system about the pattern letters, they do not know whether they have a full set or not. Perhaps the pattern must wait until they secure some, or they may use a smaller size than they should. We have seen this state of things in what might reasonably be termed well conducted pattern shops, that are weak only in a few particulars.

Shop at Portsmouth Navy Yard.

This address was illustrated with a large number of lantern slides showing views of modern pattern shops and their equipment. One of the most interesting shops referred to was that at the Portsmouth navy yard, Portsmouth, N. H. It was described as follows:

"The building is 200 feet long, 81 feet wide, and is three stories high. The height of the first story is 20 feet, second story 18 feet, and the third, from floor to ridge pole, is about 20 feet. The walls are of brick, 20 inches thick, and a 20-inch cross wall in the center extends through from foundation to roof, with the necessary openings for elevator doors and entrances. Openings are closed with self-acting, fireproof doors. The frame in the interior is made from steel, columns on each side of center running from the foundation to the roof, acting as supports for the roof. All columns are concreted with cast iron shoes at the floor running up 5 feet around columns, and concreted behind the shoes. The floor frames are very heavy girders. Those in the floors are 12 x 30 inches; floor beams, 4 x 12 inches, made from I beams, and this, with the filling in of concrete between and around the girders and floor beams, eliminates all vibration in the floors.

"The work rooms on the first and second floors are supplied with wood floors, and all the other floors are concrete. On the third floor, in the center, two openings 18 x 24 feet have been provided, so as to ventilate the work room on the second, and give light to the center of second floor from four large sky-lights set into the roof. This is a nice feature of the shop, plenty of light and excellent ventilation.

"The windows throughout the building are 12 x 10 feet, with three double sash in each frame and transom lights at the top. These windows in the workshop come just above the

back board of the benches, giving all the light possible to the workmen. When a small force of men is employed, benches are placed around the sides under the windows, which gives a larger floor space on the sides. When a large force of men is needed, benches are placed out in the floor back to back, with the ends toward the windows. This method still gives ample light. Twelve windows are located in the work shop on the second floor and one large, glass paneled sliding door, in two sections, is located at the end of the room.

Pattern Storage.

"There are two rooms in the building for pattern storage, one each on the second and the third floor. These are as nearly fireproof as can be made, everything being concrete and iron excepting the patterns. The racks for storing patterns are made of iron, with galvanized iron shelves, each rack having four shelves, and are 10 feet long, 40 inches wide, and 7 feet high, with pieces for stiffening under the shelves. Fifty of these are in use.

"A 12 x 8-foot electric elevator, running from the first to the third floor, of 3,000 pounds capacity, is provided. All gates have to be down before the power will operate, thus avoiding danger.

"The toilet rooms provided are large and spacious, with a tiling of faced brick, 5 feet high, all around the rooms. These are not placed under the stairs or in some dark and dirty corner, but are good and clean and in the light.

"The heating system in the work rooms is piped for steam, the pipes being on the side walls and overhead at the columns, steam being supplied from the yard. The overhead pipes are within 4 feet of the ceiling and no bad effect is felt from the heat.

Lighting.

"The building is wired for electric lights. Seven large arc lamps are dropped from the ceiling in the work rooms. Two incandescent lamps on extension arms are placed at each bench, one for each end. Through the center of the shop at the machines, incandescent lamps are dropped from the ceiling. All the electric conduit piping is concreted in the floors so that no piping comes in sight. Work benches are of modern pattern, with a vise at one end and a wood trimmer at the other. At the vise end is a shelf for storing shellac pots, and at the other end a shelf with a box for holding the pattern-maker's tools. Two drawers are fitted in each bench for storing hand tools of various kinds. An exhaust and sprinkler system is being installed at the present time.

Cost.

"This shop cost $116,000, and the machinery, $30,000. The line of machines embrace some 28 tools, all but the lathes being individually, electrically driven. On the first floor are located the roughing tools, comprising a heavy surfacer, 30 inches wide; a 20-foot rip saw table carrying saws up to 24 inches in diameter; one 40-inch band resaw, and a large lathe, 12 feet long; a four-sided molder for cutting out lagging for building-up large work, and one cross cut and splitting saw for dimension work.

Double Sets of Machines.

"On the second floor two sets of machinery are installed for the purpose of eliminating the possibility of having men losing any time in waiting for a machine. The machines are so located that it takes the least possible time for the men to go from the benches to operate any machine to be put in use. Half of the machines are installed on one side of the shop and the balance on the other. The speed lathes are installed on each side, and as close to the men as possible. There are four of these. The two large lathes are placed in the center of the shop.

"The hand jointers, universal double saw tables and the ordinary 24-inch surface planers are installed, one each at each end of the room. The pit and gap lathes and the mechanical woodworker are installed at the ends of the shop.

Storage for Pattern Lumber.

"On the top floor of this building the pattern lumber is stored. The two openings on the third floor for ventilating the second floor allow all the surplus heat from the workshop on the second floor to penetrate to the lumber racks where this lumber is stored. This keeps the lumber sufficiently warm for glueing purposes. The lumber is stacked so that the heat can get all around it.

"The government believes in using a certain brand of glue for glueing together all its patterns, applying it cold. It is claimed that better service is had from the patterns than if ordinary glues were used. Cylinder patterns for compound engines, such as are used in ship launches and cutters, from which as high as 100 castings have been made, are apparently in good shape today with no parting of the joints.

"It is claimed that while this glue costs more it is cleaner and more economical to use. Possibly this admits of debate. We have used both kinds of glue in our own pattern shop, and we find our present force favor the commoner glue.

Surface Table.

"The surface table used in this shop is comparatively new and a brief description will not be amiss. It is made entirely of metal and provides a perfect horizontal surface to be used by the patternmaker as an erecting table.

"The finished top measures 66 inches long, 30 inches wide and 1 inch thick. It is heavily ribbed to eliminate the possibility of warping. Columns supporting this top are bolted to machined surfaces. One of these surfaces has a V-shaped, finished projection which rests in a recess made for it at the top of the column.

"The legs are supported on heavy cap screws by means of which independent vertical adjustments are made. One of the columns is rigidly bolted to the top, while the other, which is provided with V bearing, is loosely belted to it. This arrangement supports the top upon three points. To level the top, manipulate the cap screws on the rigid column only. Adjusting one of them, levels the top laterally, and adjusting both of them quickly levels it endwise, the V bearing acting as a pivot."

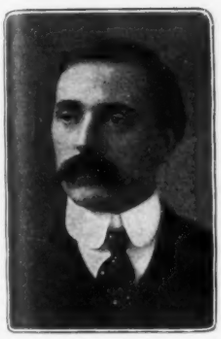
NATIONAL ELECTROPLATERS' ASSOCIATION.

The National Electroplaters' Association, organized for the purpose of advancing and disseminating knowledge concerning the art of electrodeposition of metals, including the finishing of metal generally, has been organized with Chas. H. Proctor, Arlington, N. J., president; Nathan E. Emery, treasurer, and B. W. Gilchrist, box 26, Woodhaven, L. I., secretary. A bureau of information and a laboratory equipped for research work will be maintained by this body, and meetings will be held for the purpose of presenting and discussing papers upon appropriate subjects relating to the trade. The active membership is made up of supervisors, general foremen and foremen of electroplating and finishing plants.

MAKING A LARGE COMBINATION MOLD

An interesting example of core molding combined with green sand and skin dried work---Production of the pattern

BY JABEZ NALL



WHEN considering the building of a pattern for any casting, except the very simplest, the patternmaker must choose the best of several methods of doing the work. Each has its good and bad features, and upon his knowledge of foundry conditions and practice will depend the wisdom of his final choice. We will discuss the patternmaking and molding of a base and frame of a 44 x 72-inch Blakeslee planer, which involved many difficulties. By way of contrast to the method adopted, a recital of the method pursued by another patternmaker who made the pattern for a similar casting, would make interesting reading if space would permit. Briefly, the pattern consisted of a closed-in box section of large dimensions, 10 feet 7 inches long, 7 feet 4 inches wide and 5 feet 2 inches deep, the sides being nearly parallel and only slight draft was allowed. This box section was one part pattern and nine parts core print, and it was evident that the patternmaker either miscalculated or misjudged the amount of strain that would have to be overcome in lifting the pattern out of the sand, this being augmented by the joints of the boards which extended horizontally against the lines of draft. The pattern did not come out of the sand as intended, but was drawn out of the mold in small sections. After breaking up the pattern, sufficient impression was left in the mold so that one casting could be made after considerable finishing. This method resulted in considerable lost time in the pattern shop, not considering the cost of lumber and the excess time required in the foundry for taking the pattern out of the sand.

The method pursued in making the planer base and frame did not include a bulky core print and the pattern was easily handled in storage and required no special rigging in the foundry except bars for the cope flask. In addition, it provided the simplest and most effective method for forming and securing the mold that could be adopted from a foundryman's standpoint. Attention is directed to the method of securing the cross tie bar at the bottom of the mold, Figs. 20 and 21. This will later be described in more detail.

Lacking a better word, the term "a combination mold" is used as the entire mold is the product of the method known

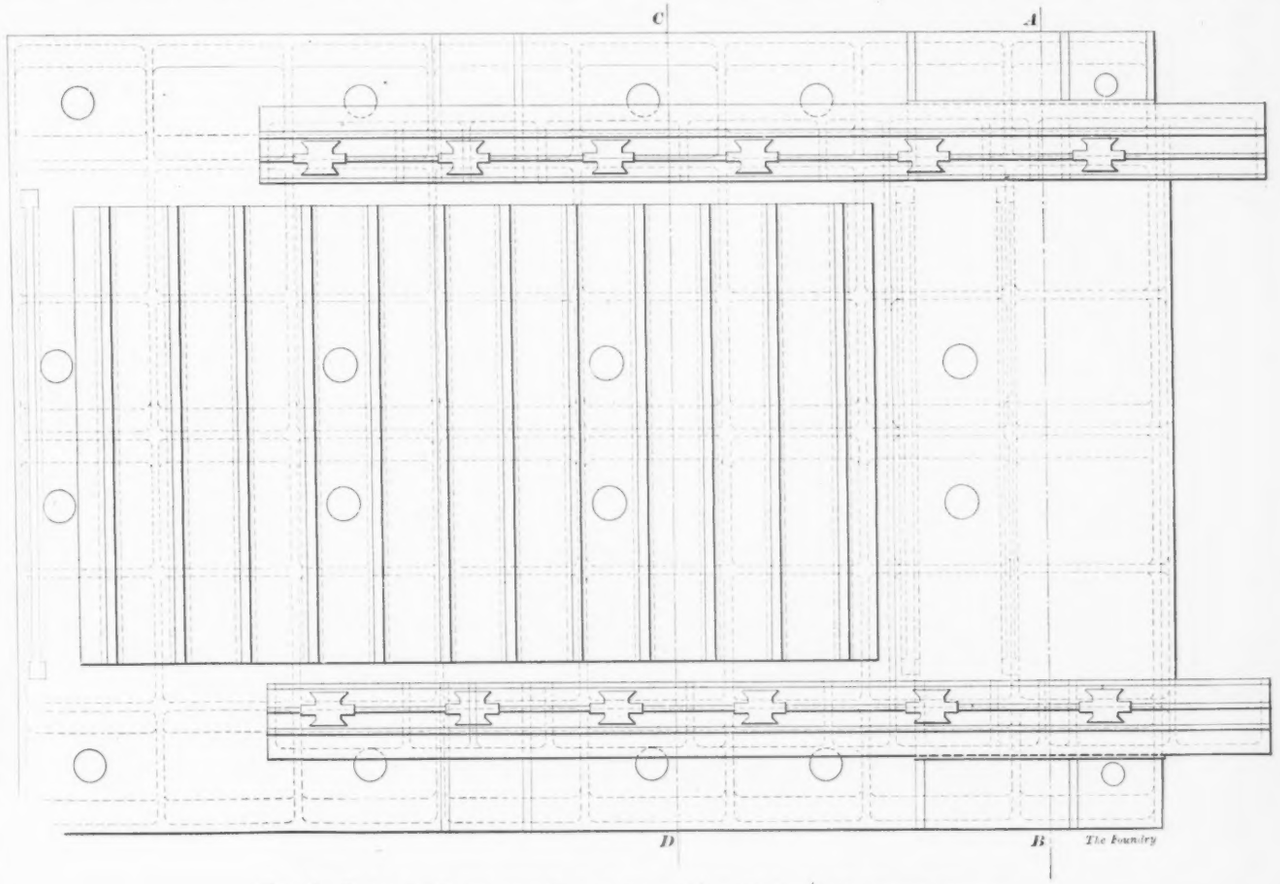


FIG. 1—PLAN OF BASE AND FRAME OF A 44 x 72-INCH PLANER CASTING

as core molding together with the ordinary practice of green sand and skin dry molding. The entire lower part of the mold is formed in cores without a pattern or other form of print. The cores

FIG. 2—SIDE ELEVATION OF THE CASTING

are held in place by what is known as "blind-ramming" of the regular heap sand. This is carried to a point about 10 inches below the top of the mold. This part of the mold is skin dried and is faced with the usual skin dry facing and is formed from a skeleton or frame pattern to facilitate the ramming of the under side and the forming of the prints for the T slot cores. To properly secure the mold a cope was used and as it was not necessary to dry this it was made of green sand. The mold was made in a regular casting pit with a screw bed.

The Casting.

Figs. 1, 2 and 3 show respectively a plan view, side and end elevations of the casting, and in Fig. 4 is illustrated an enlarged cross section of the V-ways and guides. For convenience in describing the pattern shop practice pursued in making the pattern for this casting it will be taken up approximately in the order as the several parts were required in the construction of the mold, although any piece could be made first, and on a job like this it is probable that several parts would be under construction at the same time when more than one man is at work on the pattern. The various sections will be referred to as they appear in the mold in an inverted position from that shown in Figs. 1 to 4. Thus, by referring to top or bottom cores, will denote the position in which they are set by the molder. Box A, Fig. 5, for instance is used to form the under side of the cross bar and a section of the V-ways. The construction requires little explanation in addition to the illustrations. However, despite the fact that this is not a simple piece of work, nevertheless many references which deal with elementary pattern shop practice will be omitted.

Making the Pattern.

The box is made with a frame detachable from the bottom board, pieces 1 and 2 lie loose in the box, but the latter is doweled in place to prevent its movement sideways. Center lines of the core prints for core E are shown at aa and bb. Two of these core prints are required, and their movement makes the only change for right or left hand cores. The box, it should be noted, equals in length one-half of the width of the mold at this point. When these two cores have been made, pieces 1 and 2 are taken out and the same frame and bottom board are used with the arrangement for core B as shown in Fig. 5. The blocks in the right hand corners and the short rib noted, are each doweled in position, section X forming a core print for core D, the necessity for which is shown in Fig. 21. By its use the other cores are simplified and these corners are strengthened. The illustration of core C, Fig. 7, is self explanatory, and the change from right to left hand can be made by transferring the ribs as marked. Core D, Fig. 8, is also simple in design and pieces 1 and 2 are loose and exchange places for right or left hand. Two right and two left hand cores are required. The pieces in this box are loose and are transferred for the change. Core E, Fig. 9, is shown in plan, front elevation and end section. This box forms the core for the oil chamber, the vents being

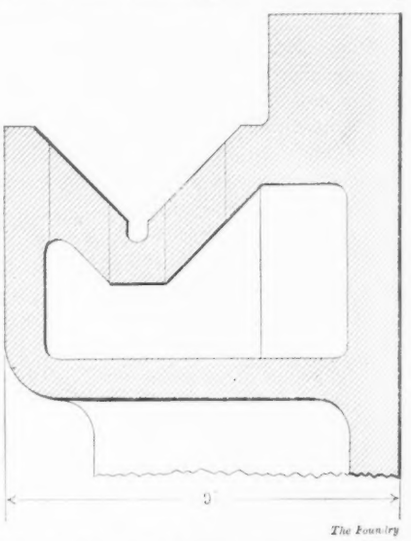


FIG. 4—ENLARGED CROSS SECTION OF THE V-WAYS AND GUIDES

taken from this core through the openings for the roller oilers, each length being arranged for two of these openings. In Fig. 21 it is shown as arranged for the end cores. The blocks at each corner of the openings are left loose for the benefit of the coremaker and to insure correct size and sharp corners at these points. The block in the box forming the metal lines is cut into suitable lengths so that the changes required can be correctly made, and a stop-off piece is required but not shown.

Cores.

Three cores for each side of the mold are necessary, the center core being arranged with core prints equi-distant from each end. Two cores are made in this way, but the others are mad right and left. Core F, Fig. 10, shows a frame box having the ribs doweled in place

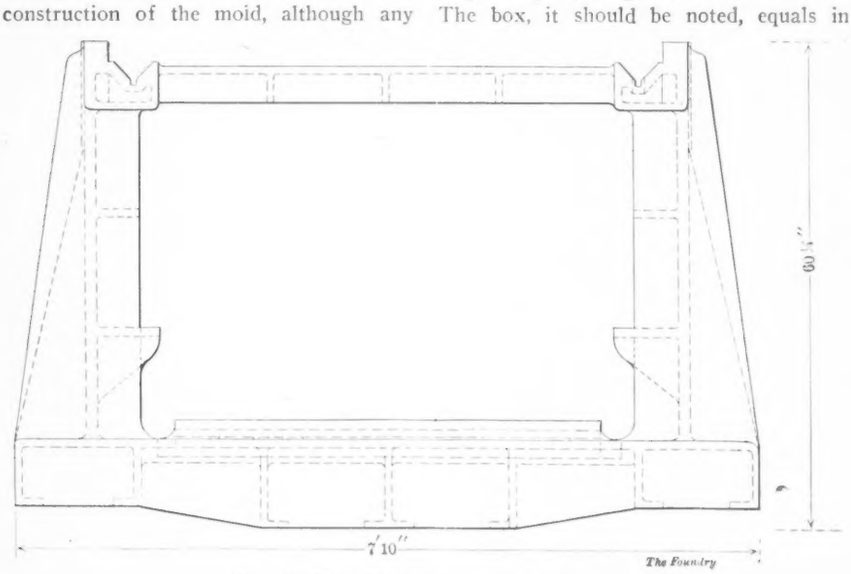


FIG. 3—END ELEVATION OF THE CASTING

with loose pins, the one rib changing over for right or left hand. This core is made with the box inverted from the position shown and this brings the extra frame to the top of the box. These extra frames form the connection between cores F and G, and shut off the metal at the plate as indicated in Fig. 10. Core G, Fig. 11, forms the reverse side of Core F, and is likewise required for right and left hand cores. This could be arranged by having the ribs straddle each other and reverse the brackets on the ribs, but it is advisable to make another set the opposite hand as was done in this instance. The short prints for the T slots, 2 and 3, are moved to the other end of the box when arranged for the opposite end, and when the cores are set in place in the mold, two full length cores prints are inserted in these impressions and form the balance of the imprint when the cores are rammed, at the same time acting as test bars for correcting the distance between the upright cores. Core H is simple in construction and is made of a proper size to separate cores A and B, and K and L. Two full length cores are required, one for each side of the mold. Pieces 1 and 2 are taken out and replaced by 3 and 4, the core being stopped off as marked. These form the ends of the casting abutting cores K and L, which require no changing.

Two cores are made from each box and together they form the two forward stands of the machine. The pieces in these boxes, if given proper draft, can be made tight in place and all necessary fillets and round corners can be formed in the pattern shop. This improves the appearance of the casting very much and obviates the necessity of the coremaker using a trowel for rounding off the corners. Core L forms the V-way of cores A and likewise forms the seat for core K and a portion of core L. Four cores are made in this box, full length, and one right and one left hand, stopped off as shown, for the end cores. Prints for core E taken from box A are used in these cores and must be arranged on the correct centers which will differ with each core. Core M, Fig. 16, forms the end of ways at the back of the casting and also a part of the runner and the gate. This box, as shown, together with its location as seen in Fig. 21, is self-explanatory and is likewise made right and left. The cores referred to are required for the lower part of the mold, but in addition, cores for the T slots are necessary, and one of these is shown in Fig. 18. The core prints are made wide so that they can be held in place without chaplets. Twenty-four of these half lengths are required, as shown, and six additional cores that differ only in the addition of a square opening for the bolt head at one end of the core.

The lightening cores for the base, Figs. 1, 2 and 3, are shown in Fig. 17. The two outside rows of cores are made without prints as they can be set on chaplets without injury to the casting, and this takes considerable weight off the cope. The other four rows are set in prints and are arranged to bolt to the cope, as chaplets are not desired on the finished surfaces. These cores are all made from one box, which is shown as arranged for the center rows of cores. The bar across the top carries the core prints for 16 of the round cores as shown in the plan view, Fig. 1. Without removing piece 6, piece 7 is added to form the new bottom of the box and 16 cores are made for the two outside rows. Then both pieces 6 and 7 are removed and are replaced by piece 8, which gives the correct height and shape to the 16 cores required for the middle row. These, together with the small round cores mentioned, include all of the cores required.

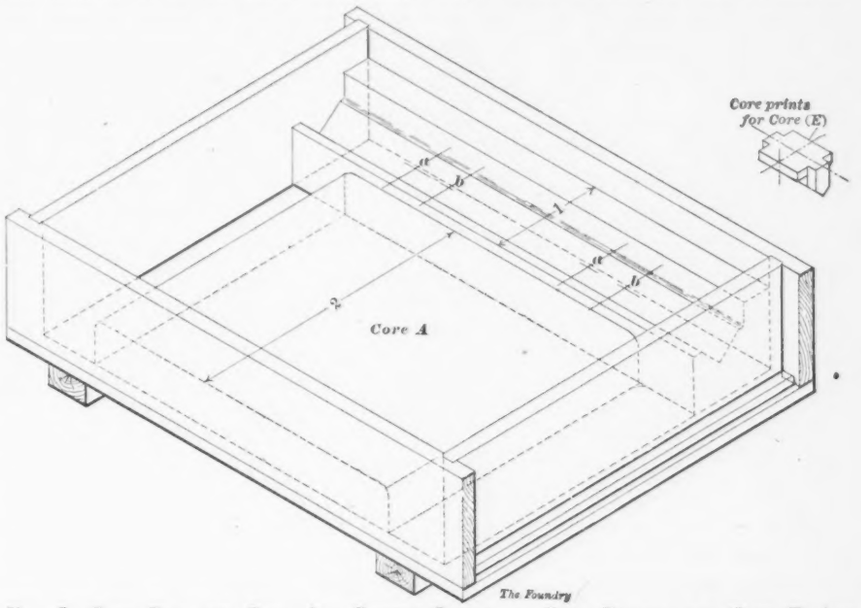


FIG. 5—CORE BOX FOR CORE A. CENTER LINES OF CORE PRINTS FOR CORE E ARE SHOWN AT a AND b. THESE ARE SET AT aa FOR FIRST CORE AND bb FOR SECOND CORE

The skeleton pattern which forms the top of the mold and the cope is then built and is shown in Fig. 19. The outside of the framework and the two middle cross bars are made of two-inch lumber, the sides running full length. The cross bars and ends are secured to the middle bars, and the corners are reinforced by blocks glued and screwed in place. These five pieces make the base of the structure. Bars of lighter material, 1¼-inch, are inserted as shown, the cen-

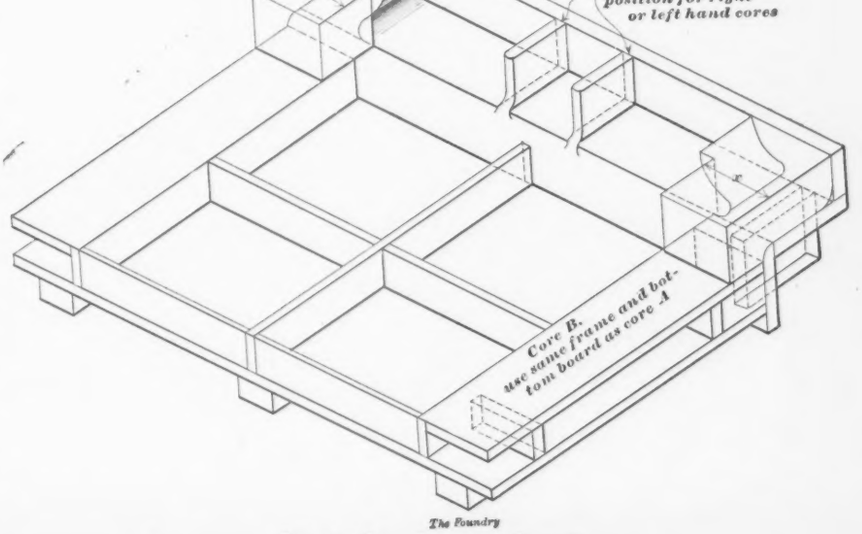

←x Prints for core (D)
This rib changes position for right or left hand cores
Core B. use same frame and bottom board as core A
The Foundry

FIG. 6—CORE BOX FOR CORE B

ter longitudinal bar being flush with the top edge. The remainder are the thickness of the top boards, 1⅛-inch, and strips are nailed on the inside of each end and on each side of the two main cross bars to form a recess of equal depth to support the top boards which are loose and removable, for convenience in ramming the sand.

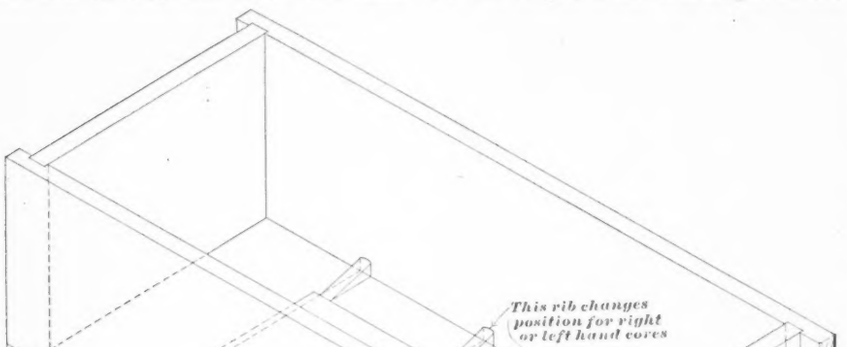


FIG. 7—CORE BOX FOR CORE C

The upper right hand section is shown with these boards in place and the core prints for cores N added. These are left loose to prevent tearing up the cope and to facilitate finishing the same. The extra metal on the under side through which the T slots pass is shown only in part in Fig. 19, and in section in Fig. 20. Bars forming the outlines of this increased metal thickness and carrying the surrounding fillet were inserted, but are not shown in the sectional view. This completes the pattern work and we offer this method for the production of these castings as a good example of foundry patternmaking.

Core molding has many advantages in specific cases of which this is only one, but it calls for great care and accuracy on the part of the molder to obtain good results. The patternmaker should provide the molder with measuring sticks for the length, width and height of the mold with the cores spaced off, so that he can correct any errors as he proceeds. The patternmaker should remember that two bricks of baked sand cannot be expected to make as close a joint as two pieces of wood that have been planed, and from ⅛ to ¼-inch should be allowed for these joints, according to the size or shape of the cores. A light fin resulting from smooth cores is preferable to a heavy one from cores that have been roughed-up with a brick. Another point favorable to this method of core molding should be brought to the patternmaker's attention. Formerly great stress was laid on the high cost of cores, core sand, etc., but with some of the binders in use today very little or practically no new sand is required, and so far as the cores are concerned they are as cheap as any other part of the mold of equal bulk.

A cross section of the assembled mold is shown in Fig. 20. At the left it is shown fully closed and ready for binding on the line A B, Fig. 1. At the right of the center line it is shown with the cores rammed on the line C D, Fig. 1, to a point where the molder is ready for the skeleton pattern, and this is shown in place resting on top of the cores F, G, K and L. Fig. 21 shows a part longitudinal section on lines E, F, G and H, Fig. 20.

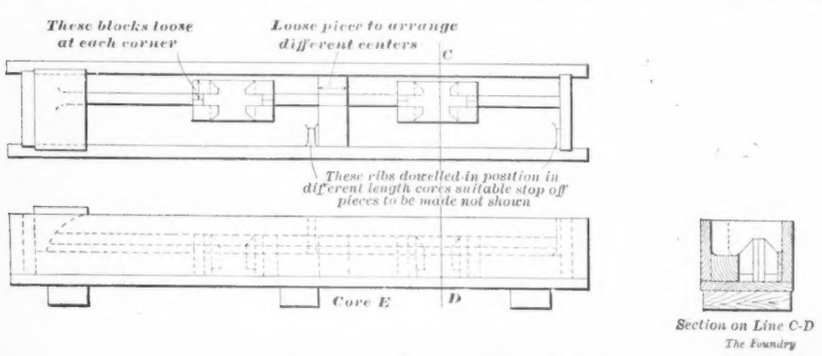

These blocks loose at each corner
Loose piece to arrange different centers
C
These ribs dovetailed in position in different length cores suitable stop off pieces to be made not shown
Core E
D
Section on Line C-D
The Foundry

FIG. 9—CORE BOX FOR CORE E

The mold should be made in a casting pit or screw bed for binding the mold together, about 15 feet long, 9 feet wide and 6 feet 4 inches deep. Upon the bottom of the pit a cinder bed, six inches deep, is laid and pipes are connected to this to carry off the gases beyond the cope flask, Fig. 20. On top of this, sand to the depth of six inches, is rammed and freely vented to the coke or cinder bed below. This forms the bed for the cores and is leveled.

Setting the Cores.

The lines of the mold are roughly spaced off on this so as to properly locate gates, risers, etc., as well as the position of the first cores A and A1, right and left hand, which are set in place, as well as cores C and C1, which abut the ends of cores A. Core E, arranged for the end core, shown in Fig. 21, is set in prints in core A. All reference to right or left hand will be omitted as the casting is symmetrical and all operations are repeated on the opposite side. Cores E are secured in place by chaplets and above these, cores B and B1 are set in position. Cores D and D1 are then laid on the latter in the prints made to receive them, the ends fitting against core C. Core F is set above core C, and cores G above B and D. Core M abuts core A and D1 and the cores I are laid on the bed on the other side of cores A. Cores I, three on each side, are set in their proper order to bring the core prints for cores E in proper position. Cores E are next placed in the mold, being secured by chaplets, and the long core from box

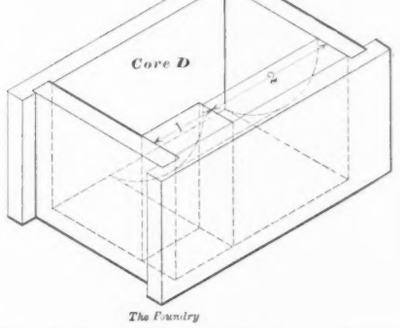


FIG. 8—CORE BOX FOR CORE D. BLOCKS 1 AND 2 INTERCHANGE FOR RIGHT OR LEFT HAND CORES

H is set abutting cores F and G, resting on core I. Cores K and L are next set in position, and the short core made in box H abuts these. This completes the setting of the lower cores which have been measured for dimensions as the operations progressed. The cores are then rammed securely to the height of cores B, and to properly secure this part of the mold against strain from the heavy head above, sand is sprinkled on these cores and on top of this is set a plate as shown in Figs. 20 and 21. On top of this plate is placed two 8-inch I beams about six feet long and across these are placed two 10-inch I-beams of sufficient length to come under the binding beam of the screw bed. Between these two beams, suitable stands are rammed of sufficient height to allow for the wedging of three beams beneath the binders after the mold is screwed down. After these plates and beams 1, 2 and 3 are in place the ramming is continued to the height shown at the right, Fig. 20. Runner cores are then added as required.

The Cope.

When the skeleton or frame pattern is set in place the openings formed by the ribs in cores F, G, K and L are carefully closed with waste to prevent sand from falling into the mold, which is then rammed up to the underside of this frame. Core prints are inserted in cores G and this part of the mold is faced with a mixture of skin dry facing and gate cores are set to connect with the first longitudinal rib at each side. The mold is then rammed to the top and the joint for the cope is made. The top cores are then set in place as well as the core prints. The cope is set and vented, is again removed and the top of the pattern is covered with green sand facing. The cope is replaced, properly staggered, rammed and rolled over. The prints being removed, the cores for the four center rows are set in their respective places, securely bolted, being supported by the flask bars. The cope is then finished and given a coat of dry blacking. The pattern is then withdrawn, the cores for the T slots set in place and this part of the mold is finished, and given a coat of wet blacking. The tops of the T slot cores as well as cores F, G, K and L are also wetted down to prevent burning during the process of skin drying. The waste which is used to prevent the sand from falling into the mold is then removed and the mold is dried. After the mold has been dried the two opposite rows of cores N are set on chaplets, the cope is replaced and the mold is clamped. In securing the binding beams care should be exercised in wedging the stands between these and the three beams previously referred to. After the pouring basin has been formed the mold is ready for the metal.

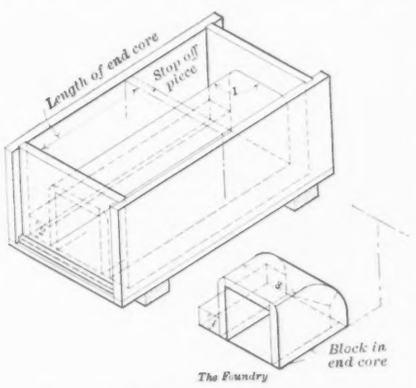


FIG. 12—CORE BOX FOR CORE H

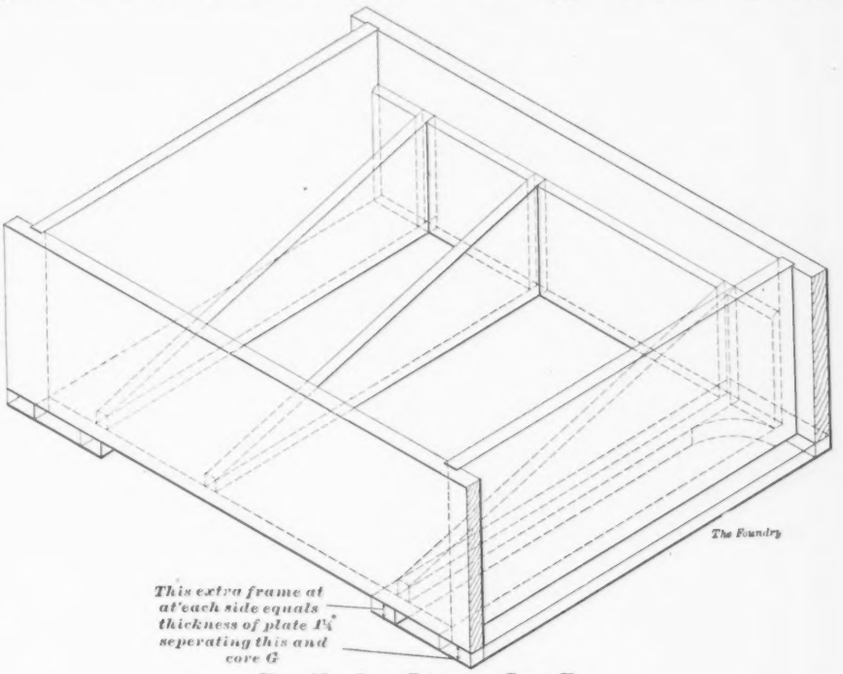


FIG. 10—CORE BOX FOR CORE F

PIG IRON TO CARRY A HIGH PERCENTAGE OF SCRAP.

BY W. J. KEEP

Question:—We have been requested to furnish pig iron which will carry about 40 per cent of heavy scrap that is to be used for light machinery castings and glass molds. Can our iron, containing 1.75 to 2.00 per cent of manganese and 0.20 per cent phosphorus, meet this requirement?

Answer:—The casting should contain 2.50 per cent silicon, and the mixture should be figured as follows: Heavy scrap, 40 × 1.75 per cent silicon = 0.70 pounds silicon. Pig iron, 60 × 3.00 per cent silicon = 1.80 pounds silicon. The casting would then contain,

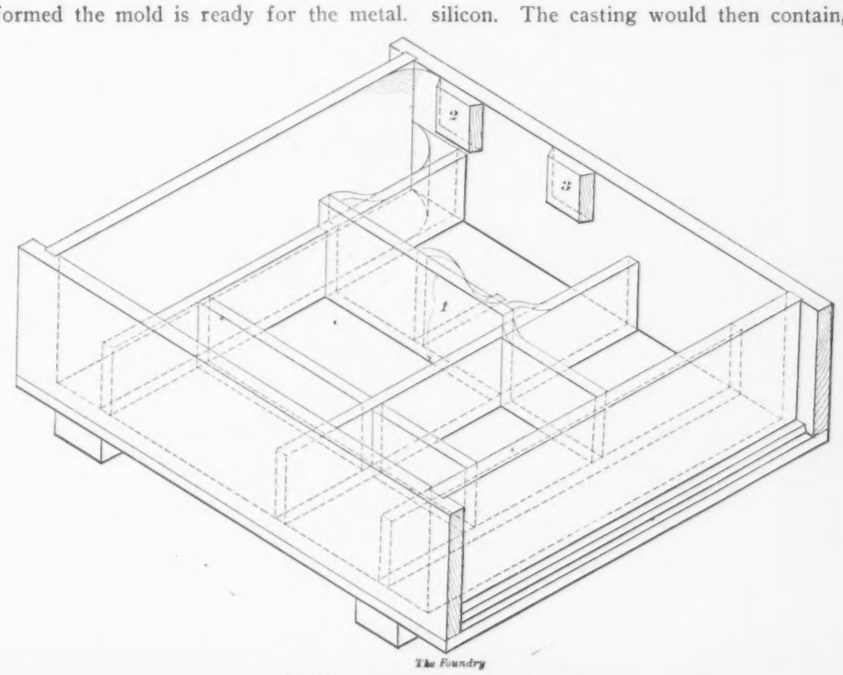


FIG. 11—CORE BOX FOR CORE G

100 × 2.50 per cent silicon = 2.50 pounds silicon. Add 0.3 per cent for loss, the pig iron should contain 3.30 per cent silicon. By the use of an iron containing 1.75 to 2.00 per cent manganese a rather hard casting would be made and the low phosphorus would probably result in a sluggish iron. The latter should be about 0.70 per cent.

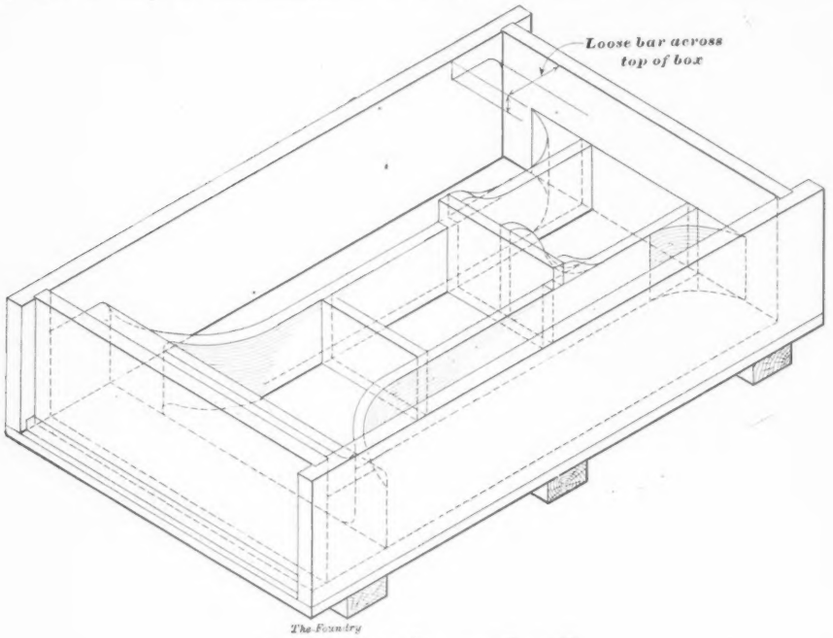


FIG. 14—CORE BOX FOR CORE K

HYDROFLUORIC ACID FOR PICKLING CASTINGS.

The following method for using hydrofluoric acid is given in an interesting booklet distributed by the Hydrofluoric Mfg. Co., York, Pa.

Upon a bench a little higher than the tanks that are to be used is placed a hollow lead tray, in which is stood the barrel. In the first tank is the water and acid, the latter being tapped from the barrel by means of a wooden spigot. The acid should always be added slowly to the water, with constant stirring. Never, under any circumstances, add the water to the acid, as a large amount of heat will be generated, and there is danger of the acid being scattered about. If large quantities of work are to be pickled, and time is an object, the pickle should be kept at a temperature of about 150 degrees Fahr. by means of a steam pipe.

The second tank from the barrel is for clear water, and the third and last tank for hot lime water. This latter should be very weak, say about five pounds of lime to a barrel of water, and it is suggested that the contents of this barrel be kept hot by a steam coil in the bottom.

Above the tanks is a track upon which is suspended the dipping box by means of a set of falls or tackle. The dipping box, or cage, is made of stout wooden strips, doweled together by wooden dowels. It is attached to the falls by means of an iron strap, sheathed with lead. The box is loaded with castings, and dipped into the first tank for 20 or 30 minutes, depending upon the condition of the work, also upon the number of times the solution has been used, and its temperature. It is then raised, run along the track, rinsed in the second tank, raised again and dipped in the third tank. After the third operation, the castings should be dried by placing the box on scantlings over the hot lime water tank or dried by heat in some manner, or by hot sawdust, preferably hardwood sawdust. It is recommended that two heavy hoops rolled in hot lead be made, and placed on the barrel of acid in use, should the acid find its way through the pitch lining and attack the hoops of the barrel.

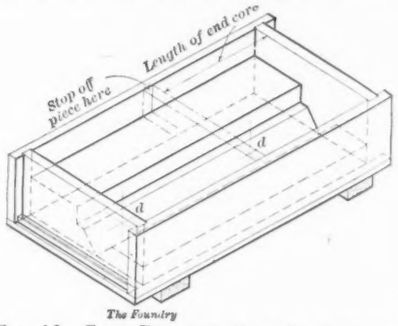


FIG. 13—CORE BOX FOR CORE I; d IS THE CENTER LINE OF PRINTS FOR CORE E, USING CORE PRINTS FROM BOX A

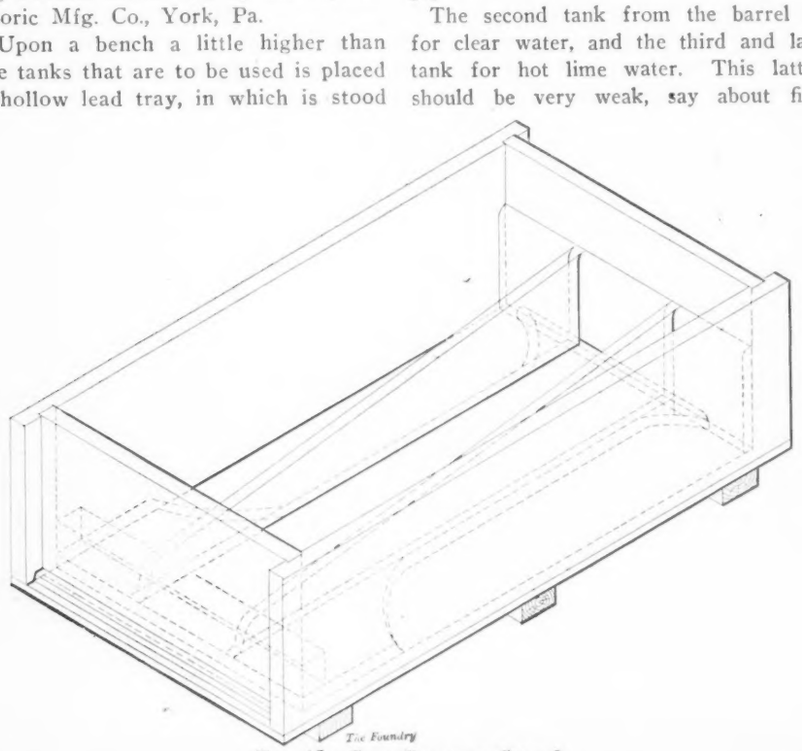


FIG. 15—CORE BOX FOR CORE L

Diluting the Acid.

Hydrofluoric acid is diluted with water the same as any other acid in preparing the pickle. As this acid acts at once on sand, glass, and all earthenware glazes, special tanks are required for holding this acid, and special dipping baskets, where they are required, should be of hard rubber, wood fiber or wood. This acid dissolves or loosens the sand, removes the scale without producing the black oxide formed by the oil of vitriol pickle, and may be obtained in inexpensive coated shipping containers of 5, 10 and 50 gallons capacity.

Barrels or half-barrels or strong wooden tanks should be well lined with prepared asphalt, applied hot. A lining of cheesecloth can be applied while still hot to prevent the work scaling the as-

)halt. The empty barrels in which acid s shipped can be used by removing the ıead or sawing them in two.

Strength of the Solution.

A little experimenting is necessary to determine the strength of the solution desired, one part of acid to 10, 15 or 20 parts of water being used for different conditions. A weak solution and longer time to clean the work gives the best results. It is well to remove all loose sand by brushing or tumbling, to preserve the strength of the solution, as one pound of sand will neutralize the acid more than would several hundred pounds of metal. Hands should be kept out of this solution by suspending the articles on wire or using rubber gloves. In case of burns, use aqua ammonia, lime water, or alkali.

For preparing work for electro-galvanizing the following can be used with advantage, but for no other solution except, perhaps, copper: Add to the diluted acid one-half pound of sheet zinc

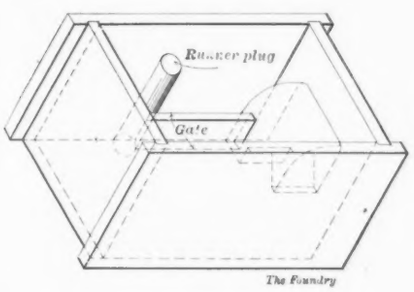


FIG. 16—CORE BOX FOR CORE M

to each 25 gallons of solution, adding an additional amount occasionally as it works out.

Removing Burnt Sand.

When melted sand resists the action of oil of vitriol, it can be removed by hydrofluoric acid. For some work a weak solution, in which the work can remain over night, can be frequently used to advantage. The solution may be used continuously by adding a little fresh acid and water to make up for evaporation. After long use, if the dip becomes too thick to wash off freely, draw off the clear liquid after settling for 24 hours, and throw away the dirt in the bottom of the tank and return the clear liquid to container.

Work that has been pickled in the ordinary way to remove sand and scale and then dried, usually has a dull, black appearance. If the work is to be polished, the black will be removed and the color restored in the polishing process; but if it is to be plated, or if it is to be left with parts of iron showing, the work should be run through the bright dip. This will bring it out white, improving the appearance and tending to make it take on a white deposit if it is to be nickeled. This dip is composed of—

Hydrofluoric acid	24 ounces
Nitric acid	10 ounces
Metallic zinc	2 ounces
Water	2 gallons

Work that is to be dipped should be strung on copper wire, and swirled around in the solution for a few seconds, rinsed in cold and then very hot water and dried in sawdust. Articles should not be allowed to stay in the dip any length of time, as they would be spoiled and the solution ruined.

Brass work requiring a satin finish may be dipped for a few seconds into a mixture consisting of—

Hydrofluoric acid	1 part
Water	3 parts

Then dry and run through the bright dip to give it a luster. If not satined enough the operation may be repeated.

A bright dip for copper, brass, bronze or German silver is as follows:

Hydrofluoric acid	4 quarts
Nitric acid	3 quarts
Common salt	Small handful.

An ormolu finish is an imitation of 22 or 24 karat gold or yellow brass. This finish is used extensively on gas fixtures, furniture trimmings, lamps, clocks and bronzes. The ormolu dip may be used on bronze oxide or copper, and produces a very rich, soft,

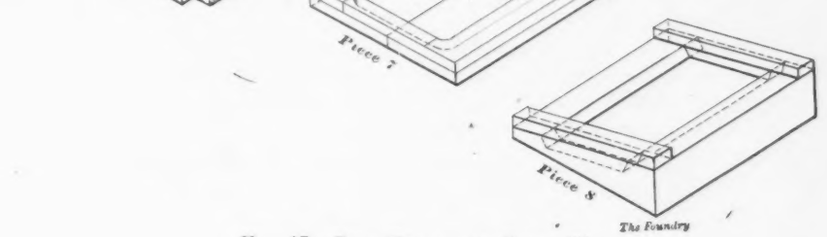


FIG. 17—CORE BOXES FOR CORES N

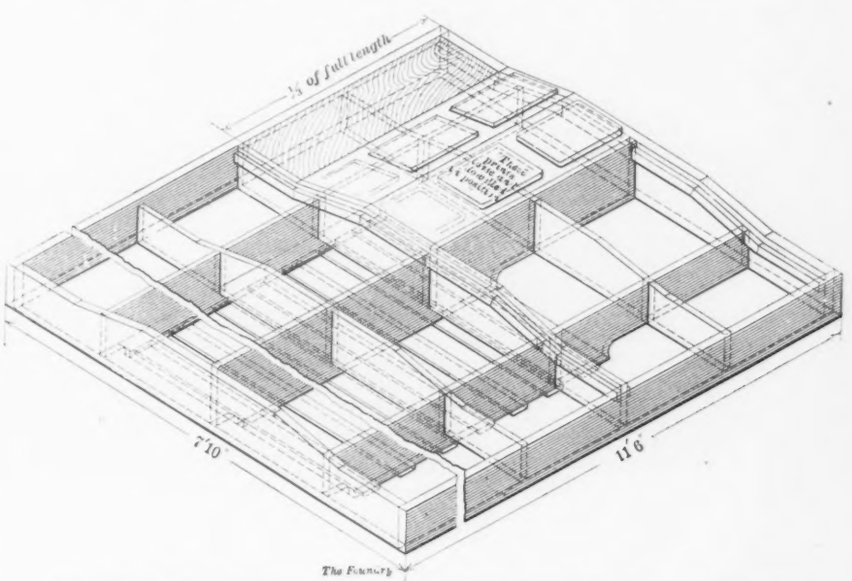


FIG. 19—THE SKELETON PATTERN WHICH FORMS THE TOP OF THE MOLD

velvety finish, which is handsome when lacquered. This dip contains the following acids:

Sulphate of zinc	5 pounds
Hydrofluoric acid	15 pounds
Nitric acid	15 pounds
Muriatic acid	5 ounces
Saltpeter (nitrate of poatsh)	1 pound

In preparing, add the sulphate of zinc to the hydrofluoric acid, then add the saltpeter, which should be pulverized; stir well; add the nitric acid slowly, stirring constantly; finally add the muriatic acid in the same manner; let stand for some time before using; to be used hot.

Another dip, less complicated, is—

Nitric acid	1 gallon
Hydrofluoric acid	1 gallon
Metallic zinc (scraps)	¼ pound

As a rule, the floor of the pickling room is wet and impregnated with chemicals, and workingmen having thin-soled shoes suffer from bad colds, rheumatism, etc. For such places a modified form of the old Dutch shoe has found considerable favor. This shoe has a leather upper and a wooden sole about two inches thick. They will save many a pair of all leather shoes, and keep the feet dry. Rubber gloves are indispensable to those employed in handling acids and mixing pickling solutions.

A drop of acid coming in contact with the flesh causes a painful sore, and the injured part should at once be put in lime water or aqua ammonia, either of which should be constantly kept on hand. Plunging the affected part in water will also alleviate the pain, but the idea is to neutralize the acid as quickly as possible.

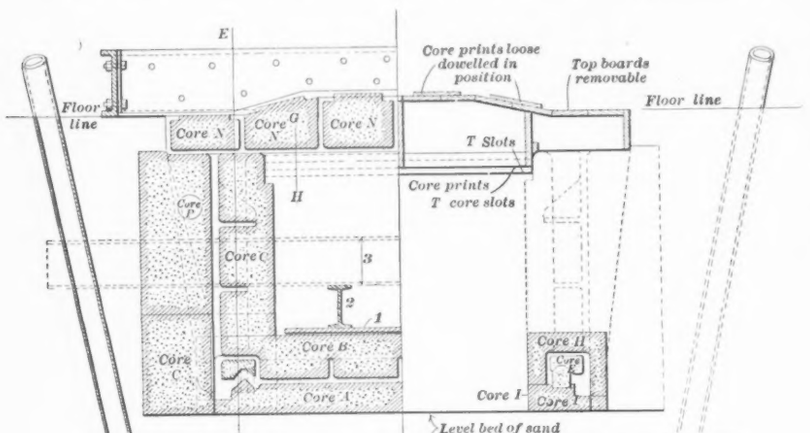


FIG. 20—SECTION OF THE MOLD ON LINES C D, FIGS. 1 AND 2

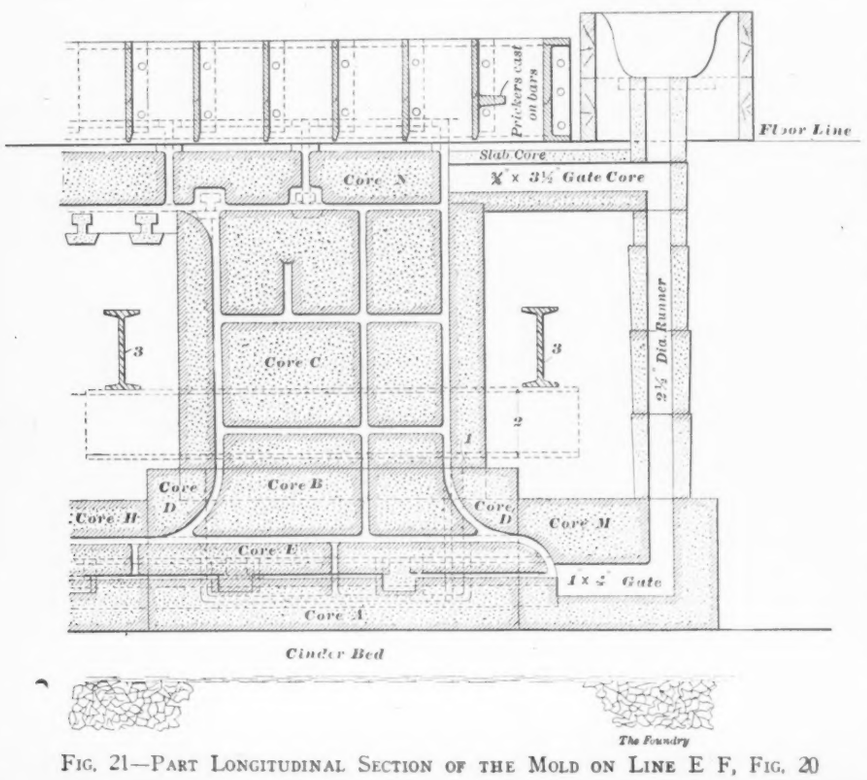


FIG. 21—PART LONGITUDINAL SECTION OF THE MOLD ON LINE E F, FIG. 20

POOR MELTING.

BY W. J. KEEP

Question:—Our cupola is practically straight inside and is 27 inches in diameter. It is provided with four tuyeres located 16 inches from the bottom. We charge 14 bushels of coke on the bed, 1,500 pounds of iron, 2½ bushels of coke and 1,000 pounds of iron. We formerly melted 8,000 pounds of iron in 1½ hours, but we have been unable to maintain this record for some time.

Answer:—The smaller the cupola the more care necessary in charging. Your bed should reach 18 inches above the top of the tuyeres after the fire is lighted and before the iron is charged. Your fire should be started two hours before the blast is put on, so that the cupola will be hot before charging the iron. I would suggest charging 500 pounds of iron on a bed of 50 pounds of coke, and so on. If the iron is not sufficiently hot, use 60 pounds of coke. You may, after a time, be able to increase the first charge of iron to 700 pounds. I think your charges are too large for a cupola of this size. It is also advisable to weight the coke as some brands are lighter than others and will give you trouble if charged by measure.

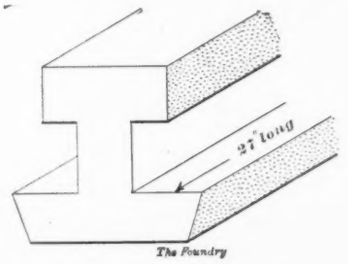


FIG. 18—T-SLOT CORES; 24 OF THESE ARE REQUIRED

The old Miles Greenwood foundry, which was placed in operation early in the 30's at Canal and Walnut streets, Cincinnati, will shortly be torn down and the site will be used for the building of the proposed Ohio Mechanics' Institute. At one time this shop was one of the most noted plants west of the Allegheny mountains, and employed 700 men. During the civil war, the foundry was engaged in the manufacture of cannons, rifles, etc., for the government.

CASTING STEAM ENGINE CYLINDERS

Methods of molding and casting various types of cylinders and valuable iron mixtures to reduce cylinder wear

BY N. W. SHED

THE molding of engine cylinders does not offer great difficulties and this work can be easily and successfully accomplished provided the proper appliances are at hand, including suitable flasks, pneumatic rammers, etc. The work can be done expeditiously if one man is employed for ramming the cope, while another is making the drag, and yet, despite the use of every modern appliance and with skilled workmanship, many defective cylinders are produced. The chief difficulties encountered by foundrymen in the production of cylinders usually result from improper gating and the casting of the metal, and frequently after these have been overcome, the cylinders may be too soft or too hard for the service for which they are intended. The accompanying illustrations show two simple forms of cylinder molds made in dry sand. Figs. 3 and 4 show the cope and drag of a cylinder for a sugar mill engine, and in Figs. 1 and 2 are shown the cope and drag of a steam hammer cylinder. When molding, great care should be exercised to have the sand well rammed and the cores should be properly vented and carefully placed. A jacket core for cylinders is now made by some foundries, which does not have to be vented. This is made of sand which has been roasted to destroy all organic matter and is mixed with pure linseed oil and the core is baked. No gas is given off when the hot iron surrounds this core, and for this reason no vent is required. Some foundrymen have not been able to make this core thus far, but if it proves generally successful, it must be considered a great improvement in the manufacture of cylinders.

Locomotive Cylinder.

A pattern of a locomotive cylinder is shown in Fig. 5. This mold is more complicated than the other two cylinders shown, and is made in a three part flask, the greater part of the casting being made in the cheek, the saddle in the drag and the lower half of the cylinder proper in the cope.

The steam hammer cylinder is poured in a horizontal position as molded. The gates, four in number, feed into the large flange at the base of the cylinder. The hot metal flows around

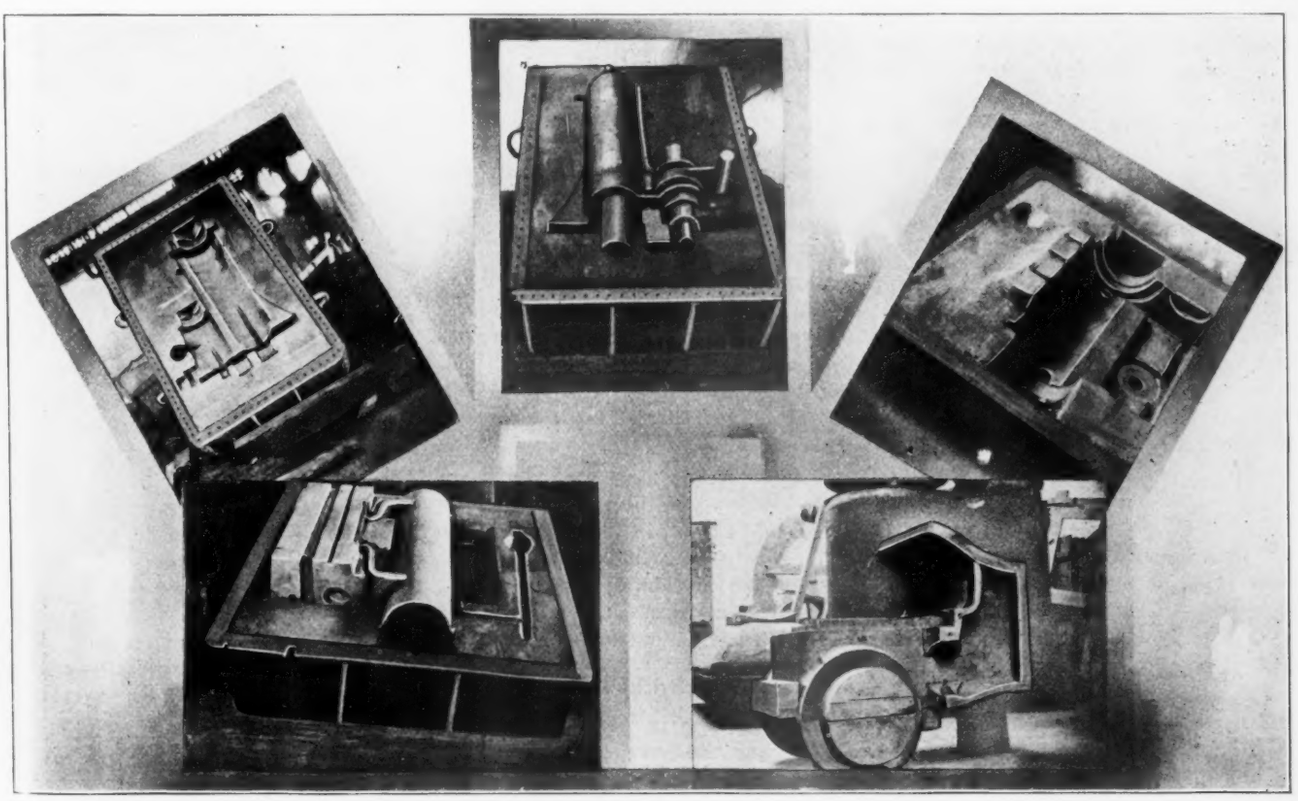


FIG. 1—COPE OF STEAM HAMMER CYLINDER

FIG. 2—DRAG HALF OF A STEAM HAMMER CYLINDER MOLD

FIG. 3—COPE OF A SUGAR MILL ENGINE CYLINDER

FIG. 4—DRAG HALF OF A SUGAR MILL ENGINE CYLINDER MOLD

FIG. 5—LOCOMOTIVE CYLINDER PATTERN

the valve cores first and then along the barrel to the top. Two risers are placed over the flange and one is located over the cap end of the cylinder. Little trouble has been experienced casting cylinders in this way, but many cylinders similar in design cast in this manner have not proven successful, and in most cases it was found advisable to turn the flask on end and to cast the cylinder from the bottom as shown in Figs. 3 and 4. It will be seen that this mold has a runner at the side with a goblet shaped bulge toward the top. This makes a reservoir where a large amount of dirt is collected.

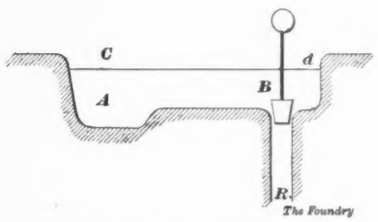


FIG. 6—SKIMMING DEVICE

A is the Pouring Box; B the Plug; Gd is the Level of the Metal and R is the Runner.

Plug for the Pouring Basin.

Another device, shown in Fig. 6, is used in the pouring basin. It consists of a small iron plug, heated and blackened, which is placed in the runner opening. As soon as the pouring trough is full the plug is slowly lifted, and the metal runs out of the trough. By this means the dirt and scum floating on the metal are kept at the top, while the trough is constantly full of metal while the casting is being poured.

In some foundries a thin piece of perforated tin is placed over the runner. This does not melt until the box is full and the floating slag and scum stay in the box. This is shown in Fig. 7.

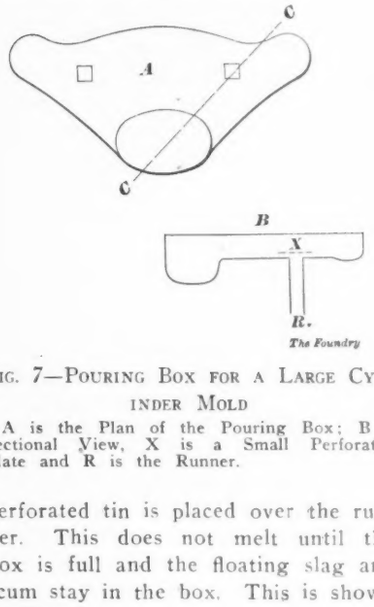


FIG. 7—POURING BOX FOR A LARGE CYLINDER MOLD

A is the Plan of the Pouring Box; B a Sectional View, X is a Small Perforated Plate and R is the Runner.

One of the most effective devices for keeping the cylinders free from dirt and slag is the skim gate designed by Mr. Lund of the Lumen Bearing Co., Buffalo, shown in detail in Fig. 8. The feeding runner to the gate is much larger than the sprue to the casting and this causes the metal to be momentarily dammed back by the small core placed opposite the intake. The curve of the core gives a slight rotary motion to the flowing metal, and the scum rises in the skim gate riser, while the clean metal is running beneath the core in the mold. This skim gate has been in use for many years for casting small cylinders made of malleable iron and alloys, but there is no reason why it should not prove valuable for casting large cylinders of gray iron.

Defective Castings.

To avoid dirt along the bore of the cylinder is the most important feature in making this class of castings. The writer has seen many cylinders rejected on account of dirt in the bore. The cylinders were made of the best metal and the molding operation could not be improved, yet, streaks and pockets of sand were found in the bore when machined. These cylinders were cast horizontally and if they had been cast on end the dirt would have floated to the top of the cylinder barrel and thence into the riser.

Unfortunately, most cylinders are made of very soft iron, although it is generally admitted that a cylinder will wear better if made of hard metal. The machinists may be somewhat to blame, inasmuch as they can show a better output on soft castings.

Iron Brick Chills.

A compromise is sometimes effected by making the bore of the cylinder hard and the remainder of the casting soft. This is accomplished by chilling the surface of the cylinder, and thereby closing the grain of the iron. Many large cylinders are made with a barrel core built up of curved iron bricks, and as the metal cools rapidly when it comes in contact with the bricks, the iron becomes much denser and a fine grain extends into the metal for a depth of at least 1 inch. Each course of these bricks has a key brick in the circle, and as soon as the cylinder begins to cool, the key is withdrawn, permitting the metal to contract. Several large users of cylinders, however, are of the opinion that the unequal cooling of the metal results in internal strains and some cylinders have cracked from this cause. Another method of chilling the surface of a cylinder is to mix cast iron borings with the facing sand. This makes the core act as a chill which conducts the heat away from the cooling metal, resulting in a close-grained iron near the bore of the cylinder.

Hard Iron for Cylinders.

There is no reason why cylinders could not be made of a much harder iron than is generally used, and the quality of the castings would be greatly improved. Not many years have elapsed since cylinders were made with silicon running from 1.80 to 2.30 per cent, but the silicon content has been greatly reduced and now averages from 1 to 1.20 per cent. The sulphur ranges from 0.04 to 0.07 per cent; phosphorus, 0.30 to 0.40 per cent, and manganese, 0.50 to 0.60 per cent. Several manufacturers use some charcoal iron in their mixtures, claiming that it closes the grain. This, however, is open to question, as the good effects of a small amount of charcoal iron are frequently lost by the too generous use of a large amount of scrap. It would be more advisable to use charcoal iron only. This would make excellent cylinders, which, however, would be too expensive for ordinary use. If a cylinder iron mixture contains from 10 to 20 per cent of charcoal iron, the good effects of its addition would be neutralized by the use of inferior pig iron and scrap. As long as good cylinders can be made of coke iron and scrap, it is advisable to save the char-

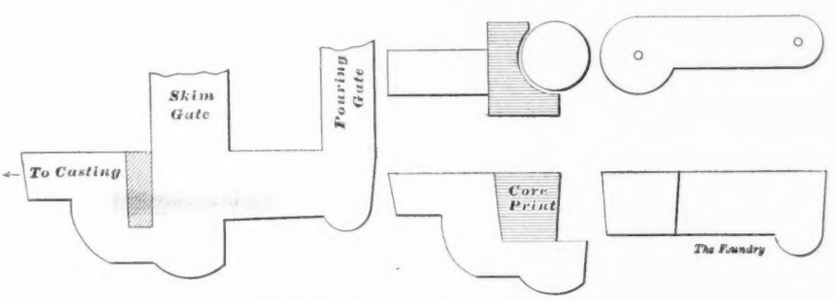


FIG. 8—LUND'S SKIM GATE

coal iron for more difficult and exacting work.

For melting cylinder iron the air furnace is the best medium. The percentage of sulphur can be held very low and the silicon can be estimated very accurately. It also affords a good opportunity for making chill tests from time to time, and the metal may be hardened or softened before it is tapped. If ferro-manganese is used, the sulphur may be materially reduced.

Foreign Specifications.

A foreign concern recently placed an order for locomotive cylinders and specified that the iron be melted in an air furnace, and that the mixture contain some charcoal iron. The mixture used was made up as follows: Low phosphorus pig iron, 20 per cent; charcoal pig iron, 10 per cent; coke iron, 32 per cent; steel boiler plate punchings and clippings, 8 per cent; low phosphorus scrap, 10 per cent, and machinery scrap, 20 per cent. This mixture contained 62 per cent of pig iron and 38 per cent of scrap and had the following analysis: Silicon, 1.20 per cent; sulphur, 0.05 per cent; phosphorus, 0.35 per cent; manganese, 0.60 per cent; combined carbon, 0.85 per cent; graphitic carbon, 2.75 per cent.

Three chill tests were made of this iron and the chill was hardly perceptible in the first. The second showed a chill of nearly ½ inch. Ferro-manganese in the proportion of 7/10 of 1 per cent of the mixture was added, and the heat was poured 20 minutes later. The physical test showed a tensile strength of 33,000 pounds per square inch and the deflection of a bar 2 x 1 x 24 inches was 7/16-inch. The iron machined easily, was close grained and had an excellent finish.

Mixture Melted in the Cupola.

An iron similar to this can be made in the cupola by using 50 per cent of coke iron, 10 per cent of car wheels, 20 per cent of steel and 20 per cent of machinery scrap. The silicon in the casting should be 1.25 per cent. This iron melted in a cupola was successfully used for cylinders more than 1 inch in thickness. For cylinders having thin walls the steel should be less, 10 to 12 per cent being a good average, and the silicon should be slightly increased.

Car wheel scrap is used extensively by some foundries for making cylinders. The castings are probably close grained and the combined carbon is undoubtedly high, but the sulphur is too great for good work. Common iron with silicon over 2 per cent and phosphorus over 0.60 per cent is giving way to low silicon, low phosphorus iron, which has greater strength and greater wearing qualities.

Semi-Steel Mixtures.

The so-called semi-steel mixture is rapidly gaining favor for cylinders. The first users of steel in cylinders, however, went to the extreme on the basis that if a little steel is good, an increased amount of steel should be better. The steel in the mixture was increased from 40 to 50 per cent, and in this way a hard metal was made, having a high shrinkage.

This metal resembled hard steel and should have been annealed like a hard steel casting. However, none of the cylinders was annealed and cracks appeared after the metal cooled. Steel mixtures rarely contain more than 20 per cent of steel scrap and many only from 12 to 15 per cent, and the castings are tough and strong without abnormal shrinkage. This metal should be poured hot. Steel should be used in the mixtures of large cylinders whether used for steam or gas. For cylinders of thin section it makes an iron that is too hard, and which frequently is white in the thinnest parts of the casting.

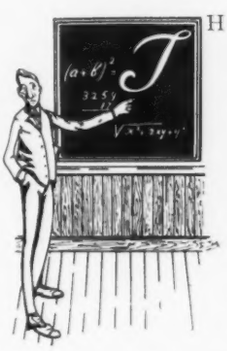
In spite of all that has been done with semi-steel and low silicon mixtures for this class of work, there are a few foundrymen who pursue the following method for making cylinder iron. This practice was actually pursued by one concern during the past year: Take charcoal iron, price about $25 per ton, melt it in a cupola, run the melted iron into runners and break this iron while hot. Melt the iron again in a cupola and if not sufficiently hard, melt over until the desired results are obtained.

If this practice can be discouraged this article will not have been written in vain.

When casting large cylinders on end, there is a danger of the top being unsound. This is due to the metal cooling as it slowly rises in the mold. If the metal is dull and the gates are small, the mold will not fill completely. This is usually overcome by prolonging the cylinder barrel one or two feet. This makes a circular riser which is cut off after the metal is cold. The cooler iron runs into this riser, while the hotter metal is in the lower part of the mold.

PRACTICAL MATHEMATICS FOR THE FOUNDRYMAN---I

BY A. C. HEMIST



THE trend of practice in jobbing shops is to get along with as little pattern-making as possible, and as a result, a large amount of planning as to the best and cheapest method of molding devolves upon the foundry. That the molders are rapidly measuring up to this new standard must be acknowledged by all who are conversant with the work produced in our best shops.

And yet there is a crying need today for more definite rules which can be applied to the various problems that arise, and which will remove them from the realms of doubt and chance to those of practical certainty.

Use of Formulas.

The use of formulas, which are easy to grasp and solve, will prove of inestimable benefit to every foreman and molder. To some a formula seems very bewildering, and a great many believe a knowledge of algebra necessary for their use. Yet, formulas can be used by any person having an ordinary education, and when properly understood are much simpler than any rule, as they are condensed, simplified rules. In formulas, symbols are used instead of words, the use of these symbols shortening the rule. They always represent some word or combination of words, and their meaning is always expressed at the same time as the formula, excepting in the case of a book or article where certain symbols are given meaning which are retained throughout the book or article.

As an illustration of the use of signs and symbols, we will consider the following simple rule. The cubic contents of a rectangular body are equal to its length, multiplied by its breadth, multiplied by its height. By using signs this rule could be shortened as follows: The cubic contents of a rectangular body = length × breadth × height, and it can be further condensed by the use of symbols,

letting the first letter of each word represent the word as follows:

Let C stand for the cubic contents of the body.
Let L stand for the length of the body.
Let B stand for the breadth of the body.
Let H stand for the height of the body.

Writing this rule the same as above, but using the symbols just given in place of the words, we have $C = L \times B \times H$, or as it is generally written, $C = L\ B\ H$. In using formulas, wherever there is no sign given, multiplication is understood. This rule must be borne in mind as it is generally taken advantage of to shorten a formula, and as will readily be seen by the use of these signs and symbols the rule has been changed to a formula, and it might be added at this point that every formula can be expressed as a rule, although it would be very difficult to express some of the more complicated so that they could be understood, for as will be seen by the foregoing illustration, a formula is not only much shorter, but also much clearer than the corresponding rule.

Signs and Their Meaning.

As has been stated, formulas are rules in which signs and symbols are used instead of words. The signs used and their meaning are as follows:

$+$ stands for add.
$\times$ stands for multiply.
$\div$ stands for divide.
$-$ stands for subtract.
$=$ stands for equals.
$\sqrt{}$ or $\sqrt{^2}$ stands for square root of.
$\sqrt{^3}$ stands for cube root of.
Z^2 stands for Z squared.
Z^3 stands for Z cubed.
$\frac{X}{X}$ stands for fractional or division sign,
and signs of aggregation are as follows: ( ) [ ] { } $\overline{\quad}$

These last signs mean that all the operations which are indicated within them are to be performed first and the resultant quantity treated as a whole number. Thus in the formula $10 \times (3 + 18)$, we would first perform the operation indicated within the aggregation sign, adding the 3 and 18, thus obtaining 21. The sign of aggregation is now removed and we would have 10×21 or 210. All the following have the same meaning as the above: $10 \times [3 + 18]$; $10 \{3 + 18\}$; $10 \times \overline{3 + 18}$. Also in the following formula $6 \{8 + 10 - 2\}$, the enclosed operation would be performed as follows: $8 + 10 = 18$ and $18 - 2 = 16$, and the formula would then read 6×16 and this would equal 96.

Simple Rules.

There are also a few other simple rules which must be observed in the use of formulas. One of these rules is that the multiplication sign is always given the precedence and multiplications are performed before all other operations, excepting those within the signs of aggregation as previously shown. Next comes the division sign, and finally the plus and minus signs. This rule must be carefully observed as it will save a great amount of annoyance. As illustrations take the following: $6 + 8 \times 4$. At first sight this would appear to mean that 6 and 8 should be added giving 14, and that this sum would be multiplied by 4 giving 56, but remembering the above rule that multiplication is given precedence then we see that the 8 is first to be multiplied by the 4, giving 32, and the 6 added to the product giving 38, this being the result instead of 56 as would at first appear. Also $40 \div 4 \times 5$ means that the 4 is first multiplied by the 5 giving 20 and the 40 is then divided by the product giving 2, instead of the 40 being first divided by the 4 giving 10, and this quotient multiplied by the 5 giving 50, as would at first seem correct, thus the answer is 2 instead of 50. Also, $20 - 6 \times 2 = 8$ instead of 28 as would at first appear and $20 - 6 \div 2 = 17$ instead of 52. With these simple rules, any person possessing a common school education can perform the calculations expressed in ordinary formulas.

Example No. 1.

For example, take the formula previously mentioned for finding the cubic contents of a square or rectangular body. It is desired to find the cubic contents of a rectangular body 10 inches long, 6 inches wide and 4 inches high. As previously shown, the formula for finding the cubic contents of a rectangular body is $C = L\ B\ H$ in which,

C = cubic contents.
L = length (in this case 10 inches).
B = breadth (in this case 6 inches).
H = height (in this case 4 inches).

What we wish to find is the cubic contents of this body as all the other dimensions are given, and the formula is $C = L \times B \times H$. If we substitute these dimensions for their respective symbols and perform the operations indicated, we will obtain the cubic contents. As the length is 10 inches, we will place 10 where the L stands, as the breadth is 6 inches, we will place 6 where the B stands, and as the height is 4 inches, we will place 4 where the H stands, and so after this change our formula will read $C = 10 \times 6 \times 4$, and performing the operation indicated $10 \times 6 = 60$ and $60 \times 4 = 240$. Therefore $C = 240$, and as C stands for cubic contents, and as all other measurements are in inches, then the cubic contents of a rectangular body of the dimensions given will be 240 cubic inches. The problem just given has been worked out in great detail, and a number of unnecessary steps shown. We will now proceed to illustrate the actual operation of several other very simple problems by means of formulas without these detail steps being shown.

Example No. 2.

Find the surface area of a plate, 52 inches long and 30 inches wide. The formula for surface areas of rectangular plates, $A = L\ B$ in which:

A = area
L = length
B = breadth

and substituting the dimensions given for the symbols L and B we have the following: A = 52 inches $\times$ 30 inches; therefore, A = 1,560 inches, and so the area of the surface of such a plate will be 1,560 square inches.

Example No. 3.

Find the surface area of a round plate 90 inches in diameter. Formula for surface area of round plates is $A = D^2 \times .7854$ in which:

A = area
D = diameter

D^2 reads D squared, and means D $\times$ D or diameter multiplied by diameter. Substituting the dimensions given in the above example we have the following: $A = 90^2 \times .7854$, and if we wish to make this clearer we could write $A = 90 \times 90 \times .7854$, and performing the operation indicated, then A = 6361.74, therefore the surface area of a circular plate, 90 inches in diameter, equals 6,361.74 square inches.

Example No. 4.

Find the area of a triangle 4 feet high and 3 feet broad at the base. Formula for areas of triangles: $A = \frac{H\ B}{2}$ or as it might be written $A = H\ B \div 2$. In this formula:

A = area
H = height
B = breadth at the base

Then substituting $A = \frac{4 \times 3}{2}$ and reducing the upper number, we have $A = \frac{12}{2}$, and as the dimensions are all in feet, then the area equals 6 square feet.

Example No. 5.

Find the area of a five-sided polygon with sides 5 feet long, and which

is 8½ feet across at its narrow point. Formula for finding the surface area of a polygon containing any number of sides is, $A = \frac{L\ B\ N}{4}$ in which

A = area
L = length of one of the sides
B = breadth across the narrowest points
N = number of sides

Substituting in the above formula, $A = \frac{5 \times 8\frac{1}{2} \times 5}{4}$, and performing the operation indicated above the line we have $A = \frac{212\frac{1}{2}}{4}$, and performing remaining operation, A = 53⅛ square feet.

Example No. 6.

Find the surface area of a sphere or globe 20 inches in diameter. The formula for the above is $A = D^2 3.1416$, in which

A = area
D = diameter

Substituting in the above, $A = 20^2 \times 3.1416$, and this reduced, is $A = 400 \times 3.1416$. Therefore, A = 1256.64 square inches, this being the surface area of such a globe or sphere.

The general formulas already shown will occasionally be found useful to foundrymen. In the cases where the formulas cover the finding of areas, they can be extended to find the cubical contents (excepting in the case of the sphere) by multiplying the area by the thickness of the body. Thus in the case of the circular plate, assume the thickness to be 4 inches, then the cubical contents will be 6361.74 × 4 = 25446.96 cubic inches. This can farther be extended to find the weight by multiplying by 0.26.

INTERESTING EXPERIMENTS WITH BRASS VALVE MIXTURES

IN THE March issue of THE FOUNDRY was published a table of brass valve mixtures used by some of the leading manufacturers of the United States, which comprise alloys that have a wide range of usefulness in the brass foundry. They are of such value that the writer cannot pass them without comment, as there may be some who have not observed or fully understood them. It will be noted that of the five alloys given, only one contains iron. This metal is not an impurity dissolved from pokers and skimmers, but is added for the purpose of closing the grain and making the metal more resistant to the action of steam at high pressures. For other purposes than high pressure steam goods, the iron should be omitted, as the castings will show a better external color.

Good Mixture for Steam Goods.

The formula of No. 1 is as follows: Copper, 87.28 per cent; lead, 4.7 per cent; tin, 7.15 per cent; iron 0.27 per cent, and zinc, 0.61 per cent. This alloy was tried first and was used as follows: Copper, 87 pounds; tin, 7 pounds; zinc, 1 pound; lead, 5 pounds, and iron ¼-pound. On account of the iron which this mixture contains the metal is not very pleasing in appearance, but the fracture is very close and good. The alloy is hard, easy to machine and is excellent for all steam goods.

The mixture published in Table 2 is a cheaper alloy and very high in lead. The mixture tried contained: Copper, 77 pounds; tin, 4 pounds; zinc, 6 pounds, and lead, 13 pounds. The castings made from this mixture were easily machined, bent readily, but were not very pleasing in appearance.

The third mixture was tried as follows: Copper, 88¾ pounds; tin, 4¼ pounds; zinc, 4 pounds; lead, 3 pounds. This proved to be an excellent soft bronze for small castings.

Globe Valve Mixture.

The globe valve mixture is the best of the series for general brass work. In all of the alloys except the first the iron was omitted, as the zinc content is sufficiently high to insure solid castings. This alloy can be modified to advantage as follows: Copper, 85 pounds; lead, 6 pounds; tin, 4 pounds, and zinc, 5 pounds. Brass founders who are looking for an alloy giving a beautiful golden appearance had better try this as it answers the purpose in every respect.

In the radiator series, No. 3 was found to be of the best color. The formula used was: Copper, 89½ pounds; tin, 4½ pounds; lead, 4 pounds, and zinc, 2 pounds. This is a very pretty alloy in appearance and the metal is good.

No. 1 radiator alloy is a good tough metal, will bend double, and can be used for such castings as trolley car splicer ears and other overhead castings used on trolley systems. The formula used contained copper 87¾ pounds, tin 3 pounds and 10 ounces, zinc 7 pounds, and lead 2 pounds. No. 2 is similar but cheaper. The mixture tried contained copper 83½ pounds, tin 2 pounds and 10 ounces, zinc 8 pounds and lead 6 pounds.

The metal made from the mixture given in No. 4 will bend, but the appearance of the castings is not pleasing, as the content of the zinc and lead is high. No. 5 contains no tin. The mixture tried consisted of copper 82 pounds, zinc 11 pounds, and lead 7 pounds. These castings were not particularly pleasing in appearance. The metal, however, was bent at right angles without cracking, and the only other advantage possessed by this alloy is its cheapness.

Alloy for Bearings.

Mixture No. 6 is better and contains copper 84 pounds, tin 3 pounds, zinc 9 pounds, and lead 6 pounds. The color was not brilliant but the castings were clean. The metal is stiff, somewhat hard, and will pass as a hard brass, being a good cheap alloy for bushings and small bearings. It will bend at right angles but cracks beyond that.

The above alloys were the only ones tried, the others being so similar it was not considered necessary to continue the experiments further. The globe valve mixture, No. 4, produced castings having the best color. No. 3 of the radiator series was also good in that respect. Mixtures Nos. 1 and 5 in Table 1 are good steam metals and can be recommended for such work. Those running high in lead and zinc will afford a selection for a cheap red brass.

K. K.

PITTSBURG FOUNDRYMEN'S ASSOCIATION.

At the April meeting of the Pittsburg Foundrymen's Association, held at the Fort Pitt hotel, Harrington Emerson, New York City, discussed efficiency in plant organization and operation. Secretary F. H. Zimmers presented a number of letters from foundry appliance manufacturers favoring the establishment of a permanent exhibit of foundry equipment at the Carnegie Technical Schools, Pittsburg. No definite action will be taken until after the meeting of the American Foundrymen's Association at Cincinnati.

MOLDING EIGHTY-TON ENGINE FRAMES

Methods of producing large castings in the plant of the Mesta Machine Co.---Another example of pit molding

WHILE close attention to every step and detail is of importance in all casting operations, it is necessarily a factor of prime consideration in extremely heavy foundry work. The casting of large, gray iron beds for heavy duty Corliss engines by the Mesta Machine Co., Pittsburg, is representative of the manner in which the difficulties and problems which are incident to this class of work, are met and solved. In the engine bed plate, strength of structure is of essential importance, and the means by which this and other qualities are obtained, involves an interesting continuity of operations.

Preparation of the Casting Pit.

The first step in the molding operation is the preparation of the pit, which, in the Mesta plant, is 55 feet long, 14 feet wide and 15 feet deep, and is excavated down to solid clay. The bottom plates which extend across the width of the pit are laid down, end to end, and the surface is then leveled. The plates have ribs cast on their underside which extend 12 inches beyond each end of the mold. A heavy stirrup is inserted over a lug on the bottom plates forming a tie, and these loops extend 6 inches above the floor line. Open sand plates, 2 inches thick, and of a height to bring them within a foot of the floor level are set on end, around the entire wall surface of the pit, forming the enclosure for the mold.

Much ramming work is required, and this is done carefully with pneumatic rammers. A good grade of clay is used and is rammed in the pit 6 to 7 feet high, around the side plates, insuring a solid background. A layer of clay, about 4 feet in depth, is placed upon the bottom plates, followed by a foot of sand and both are carefully rammed in turn. The coke bed is then laid to bring it at least 2 feet from the bottom of the pattern, and the pipes, five on a side, are inserted to draw off the gases. The top layer of the bottom of the mold is rammed above the coke bed and the pattern dropped thereon so as to bring it on a level with the floor line. The pattern is then rammed in the usual way.

The setting of the cope, which is in two sections, follows. After the gates are made and the cope rammed, it is lifted and the pattern drawn. The mold is now ready for dressing which follows the usual practice, blacking being applied. Close attention is given to the drying of the mold. Special burners, curved to suit the conditions of the mold and placed as near as possible to the bottom, are employed. The fuel is natural gas, and the jets are kept on 60 hours. During the drying process the entire top of the mold is covered with corrugated sheets which rest on supports to allow an air space of about 3 inches.

While the pit and mold are being prepared, the cores are made and baked. As soon as these have been thoroughly dried they are placed in an oven of low temperature which prevents the absorption of moisture while they are waiting to be set. After the gas jets are taken out, the entire mold is gone over closely to see that no blistering has taken place while being dried.

The setting of the cores requires special accuracy and care. After coming from the holding ovens and be-

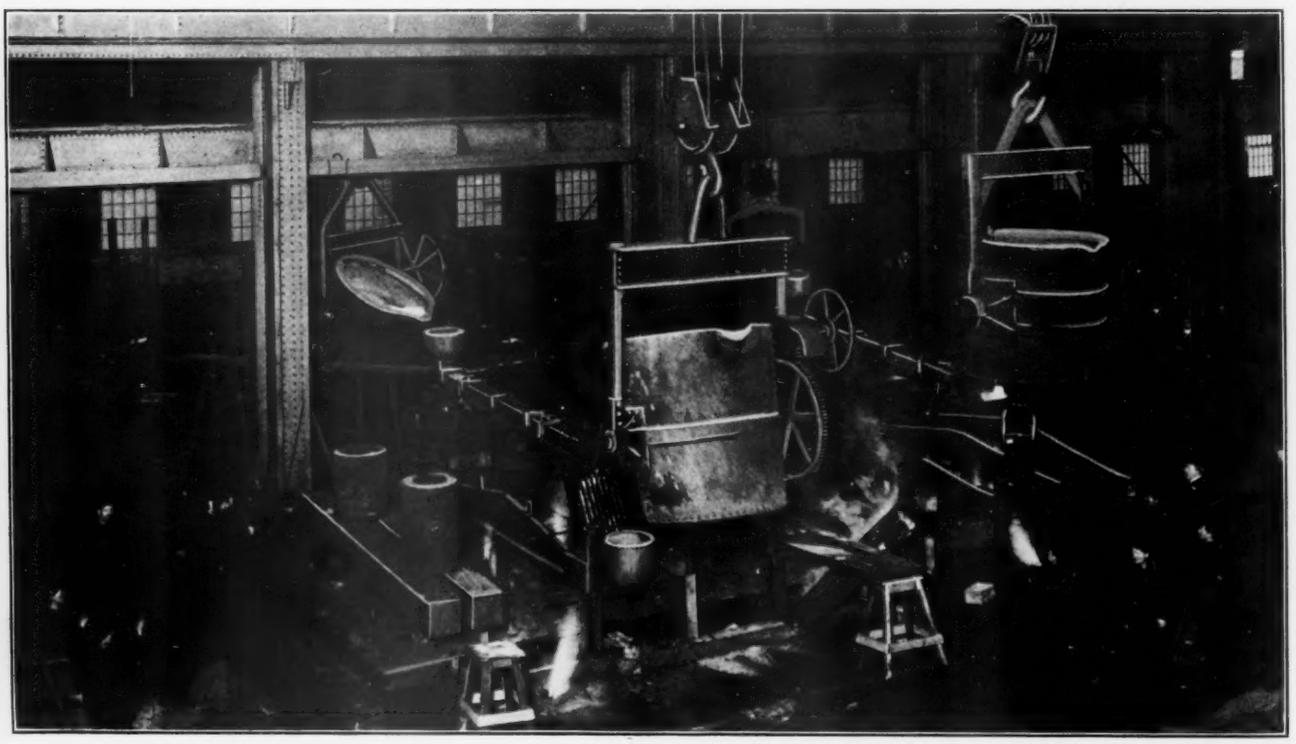
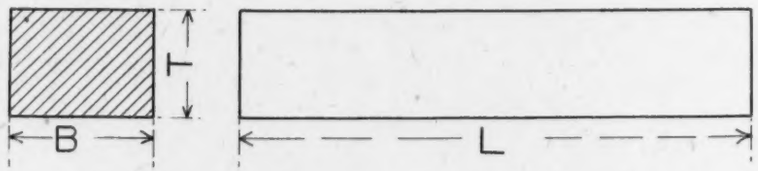


FIG. 1—POURING A 160,000-POUND ENGINE FRAME CASTING IN THE FOUNDRY OF THE MESTA MACHINE CO.

FORMULAS FOR FINDING THE WEIGHT OF IRON CASTINGS.

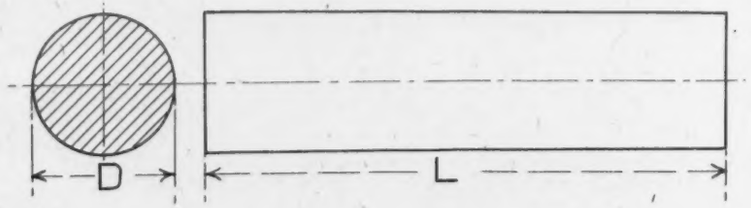
To find the weight of square or rectangular castings, multiply the length by the breadth, by the thickness, by 0.26 ——

$$W = L\ B\ T \times 0.26.$$



To find the weight of solid cylinders, the weight equals the outside diameter squared, multiplied by the length, multiplied by 0.204 ——

$$W = D^2\ L \times 0.204$$



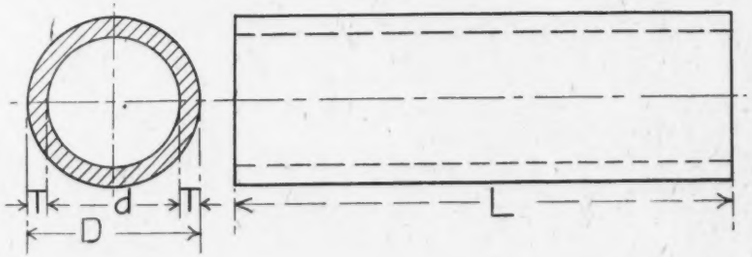
W = Weight of casting in pounds.
L = Length of casting in inches.
T = Thickness of casting in inches.
B = Breadth of casting in inches.
D = Outside or large diameter in inches.

Data Sheet No. 41, The Foundry, May, 1909.

FORMULAS FOR FINDING THE WEIGHT OF IRON CASTINGS.

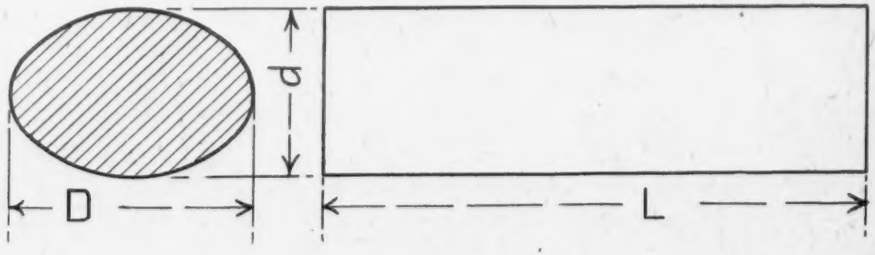
To find the weight of hollow cylinders, multiply the small or inside diameter plus the thickness, by the length, by the thickness, by 0.817 ——

$$W = (d + T)\ T\ L \times 0.817.$$



To find the weight of a solid ellipse, multiply the large diameter by the small diameter, by the length, by 0.204 ——

$$W = D\ d\ L \times 0.204.$$



W = Weight of casting in pounds.
L = Length of casting in inches.
T = Thickness of casting in inches.
D = Outside or large diameter in inches.
d = Inside or small diameter in inches.

Data Sheet No. 42, The Foundry, May, 1909.

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

THE FOUNDRY DATA SHEET, MAY, 1909.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication.

fore being set, they are inspected to see that all vents are open. Great skill is required to insure the correct thickness of the ribs and webs. For this work, iron chaplets 3/16 x 1½ inches are used. The preparation and care of these chaplets are given close attention. After coming from the blacksmith shop they are placed in a tumbling barrel to remove the scale. To prevent corrosion, they are stored in a dry place until ready for use.

Setting the Cores.

The core work is quite extensive, and the problem of transporting the cores from the ovens to the pit is one of importance where crane facilities are taxed. The Mesta company has solved this problem in a satisfactory manner by the use of a small traveling jib crane which runs to the molding floor, delivers and sets the cores without interfering with the operation of the large cranes.

After all the cores have been set, the vent cores are placed. These are firmly attached to the main cores with flour paste. Flour is sprinkled upon the vent cores and upon the parting. The cope is tried and lifted off and the parting is examined to insure a perfect closing of the mold. Precaution is taken to secure absolute dryness in the mold by applying a gas burner for several hours after the main cores and vent cores are set. When the cope has been put on for the last time, heavy tie bars are put in position, 4 feet apart, hooked to the rings at the edge of the cope.

Pouring the Mold.

The pouring of the mold is especially interesting owing to the large amount of metal to be handled within the shortest possible period. Runners are placed on each corner of the mold and are served by four large ladles. Three of the ladles pour to the bottom of the mold at the same time. One ladle is reserved until the iron rises to the point where it flows over the top of the cores. The last ladle is then poured upon the upper part of the mold and the hot metal flows over the top of the cores. The final pouring is through a sprue which facilitates the spreading of the metal across the top.

For the casting of a 160,000-pound bed plate, as illustrated, a number of which have recently been made by the Mesta Machine Co., practically 168,000 pounds of metal are run into the ladles. The preparation and handling of this amount of iron necessitates a large furnace equipment and ex-

FIG. 2—METHOD OF SETTING THE CORES IN THE MOLD FOR A 160,000-POUND ENGINE FRAME CASTING BY THE USE OF A SMALL TRAVELING JIB CRANE

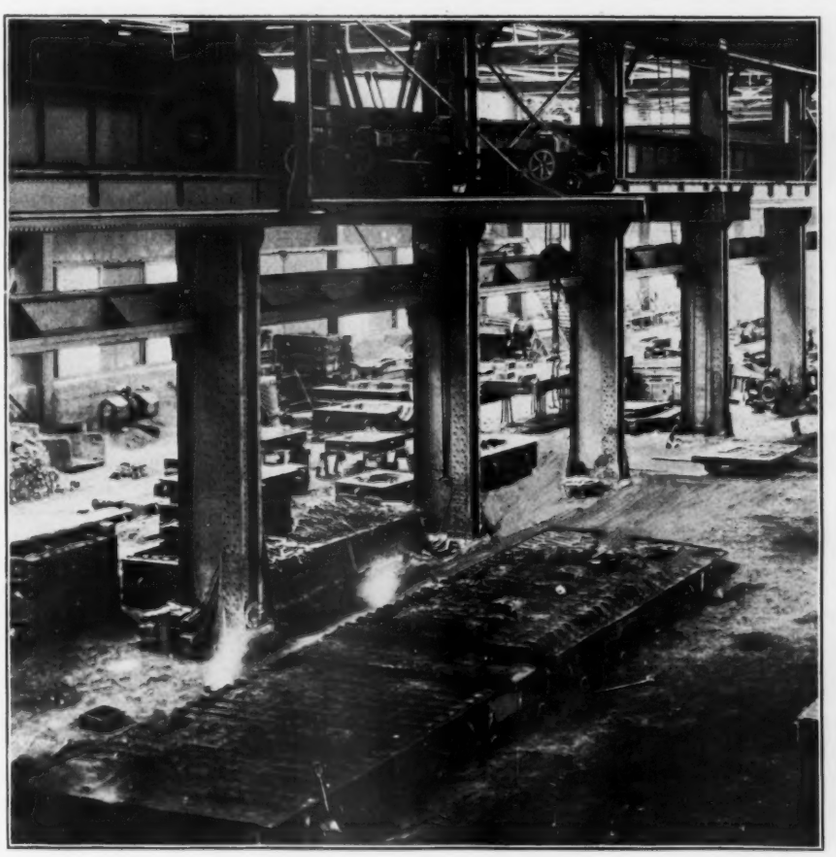


FIG. 3—VIEW OF THE PIT IN WHICH THE ENGINE FRAME IS COOLING. THE CASTING IS LEFT IN THE SAND ONE WEEK BEFORE BEING REMOVED

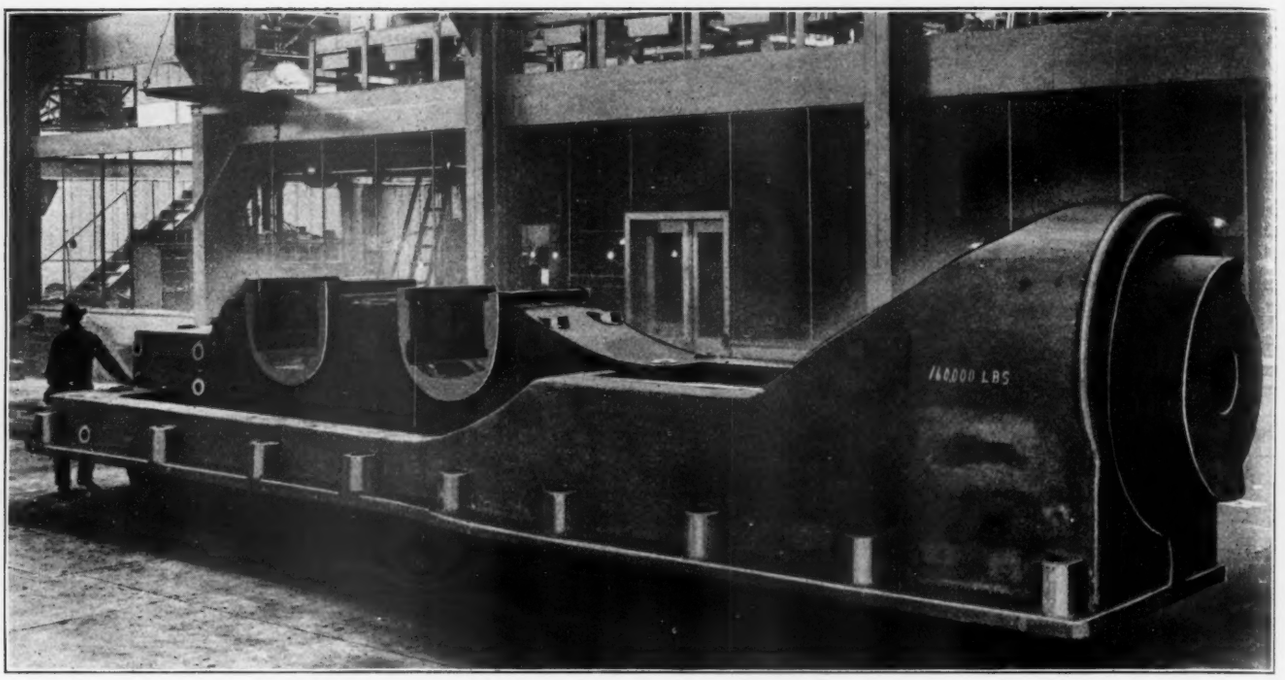


FIG. 4—THE FINISHED ENGINE FRAME CASTING

tensive crane service. Three air furnaces of 45 tons capacity each are used, and the single charge in each furnace is 58,000 pounds. The charges are so arranged that the last furnace is ready for tapping within 20 minutes of the first and approximately 30 minutes are allowed for raising the metal to the required, uniform temperature, one employe doing the gaging for all furnaces. The furnaces are tapped simultaneously, and a lapse of 30 minutes covers the time from the first run of the heat to pouring. Various tests, both chemical and physical, are made of each furnace heat. The four ladles used, range from 20 to 35 tons each. The casting is allowed to remain one week in the sand. By means of the tie bars, which are bolted down during the cooling process, the cope and floor plates are held securely in place and the entire mold remains intact while the metal is in a fluid state. This insures the uniform cooling of the casting.

The time required for the complete casting operation, from the preparation of the pit to the time when the casting is shaken out, is about four weeks, when conditions are especially favorable and rapid work is possible.

The Partamol Co., 415 Broadway, New York City, has issued a neat folder describing its parting compound and its application for foundry use.

CHILLED IRON CASTINGS.

By W. J. KEEP

Question:—We make gray iron castings and would like to make a few pounds of chilled iron castings each day. What can we add in the ladle to do this?

Answer:—Break up ¼-pound of sulphur into rather small pieces. Place this in a 50-pound ladle into which the molten iron is poured. Cast this into molds containing the chills. If the chill is too deep, use less sulphur the next time.

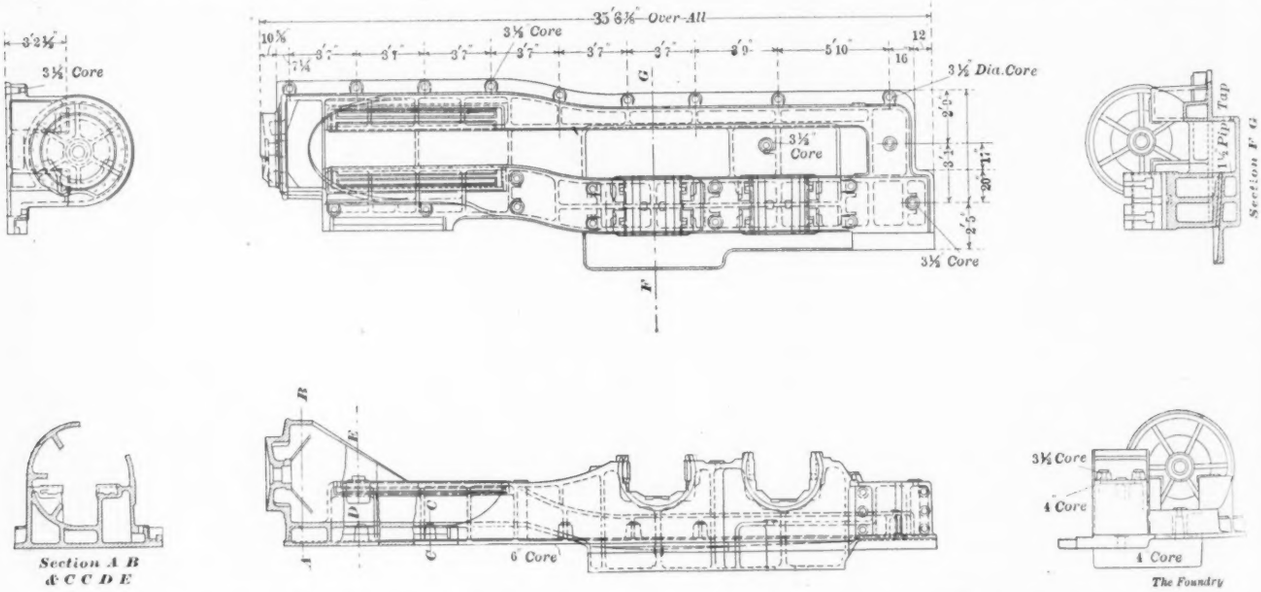
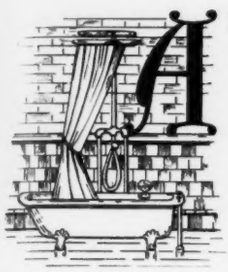


FIG. 5—PLAN VIEW, SIDE ELEVATION AND SECTIONAL VIEWS OF THE PATTERN FOR THE 80-TON ENGINE FRAME

ENAMELED CAST IRON SANITARY WARE--III

Production of the first cast iron pattern from the lead, tub pattern- -Method of molding and filing the pattern

BY DILLEN UNDERHILL



AFTER the lead pattern has been finished we follow the tub pattern, in its regular course of manufacture, into the hand tub foundry. Figs. 3, 4 and 5 show in correct sequence how the mold is made. The styles of cast iron sprues generally used on hand made tubs are shown in Figs. 1 and 2. As shown in the plan views, they are rounded on the ends and are made about 2½ inches wide, 6 inches long, and taper to four, ½-inch rounds at the bottom, as shown in Fig. 1, and a ¼-inch edge as shown in the other type, Fig. 2. The height of the sprues is usually about 6 inches, but in all

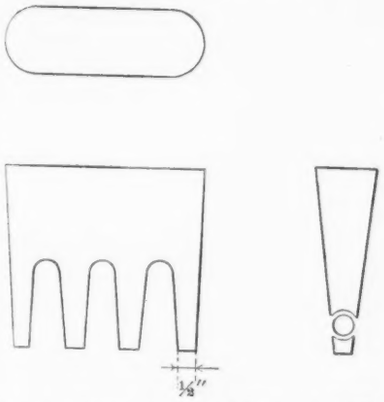


FIG. 1—SPRUE FOR THE MOLD OF A HAND MOLDED TUB

cases they must be short enough not to project beyond the top of the cope, as this would interfere with the cope follow-board, as shown in Fig. 4.

The Cheek and Cope.

The lead pattern is shown on the form and follow-board in Fig. 3, the cheek and cope are in place and the sand in these sections of the mold has been rammed. In this view a 5-foot tub is shown in section and the wood bars are also located and properly spaced. For this class of work it has been found that the bars hold the sand best when not more than 7 inches face to face, and the bars can be placed close to the pattern, provided a sufficient space is left for a wall of sand between their edges and the pattern. It will be noted that the bars in the cope are closer to the pattern than in the cheek. The cheek bars should be left a sufficient distance from the pattern so that when ramming, the molder may go all around the pattern without taking his rammer in and out of pockets, as it were.

Parting Line.

It will be noted that the parting line shown in Fig. 4 is not in the same plane as the parting of the drag and the cheek of the lead pattern. Since there are only two or three castings made from the lead pattern at the most, the sand can be rammed as shown in Fig. 3, and after the cope and cheek have been rolled over, the cheek and follow-board rammed, the sand can be cut away by the molder down to the parting necessary on the rim of the tub. In other words, the surface exposed will be dished all around the pattern. However, if desired, a beveled strip of wood may be set in entirely around the pattern so as to make the parting at the same time that the mold is being rammed.

Use of Regular Cast Iron Pattern.

Since the making of a regular hand-made tub is similar to this, many of the operations illustrated in Figs. 3, 4 and 5 are also applicable when the regular cast iron pattern is used. When the cast iron pattern is rammed, only a follow-board is required, and the form is made of strips of wood tacked together to merely prevent the pattern from shifting. On the other hand, the form shown in Fig. 3 supports all parts of the lead pattern while it is being rammed. The parting line, when the cast iron pattern is used is made parallel with the follow-board by cutting down into the follow-board, or is built up so as to make the parting line parallel with the follow-board itself. The height of the bars shown in the drag, Fig. 4, is optional. If the bottom-board is fastened securely to the drag and the sand, when the mold is in position for pouring stands up, then these bars need not reach up into the pattern and are used only as stiffeners. This is shown clearly in Fig. 5.

Finishing the Mold.

After the flask has been rammed, as shown in Fig. 4, the cope and cheek are lifted off and the pattern is removed by a crane, as it is too heavy to lift by hand and must be removed from the sand very carefully. In the hand tub foundry a jib crane works very well, and may be used to serve a number of molders, the tubs being arranged around the crane as a center. A sectional view of the mold ready to pour is shown in Fig. 5. It has been touched up wherever the sand has been jarred loose, or where a rough surface has

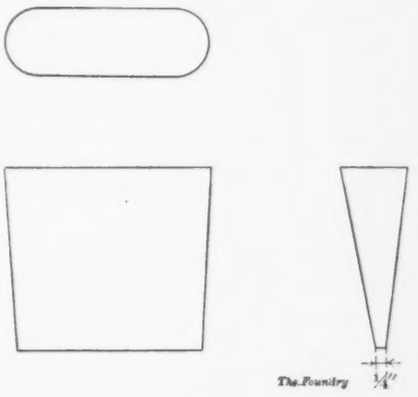


FIG. 2—ANOTHER TYPE OF SPRUE FOR TUB MOLD

been left. The ideal mold is one that requires no further finishing after the pattern has been removed. It makes no difference how skillful a molder may be with his tools, the sand, when it is slicked will not have the same porosity as when it is rammed, and in consequence the surface of the casting will not be the same as on other sections where the sand has not been slicked, and the enamel will not produce as smooth a surface. A pouring basin is shown on top of the mold in Fig. 5. It consists of a box, open at the top and bottom, which is filled around the sides

with sand. When pouring the mold the object is to have just the right amount of metal in the two ladles to fill this basin quickly and thus permit the metal to run down and fill up the mold as well as the sprue. After the casting has been made from the lead pattern, it is taken to the sand-blasting room where the sand which adheres in a thick layer on all sides of the cast iron pattern is removed. It is also ground wherever any projections, such as fins or lumps, have formed as a result of the sand falling away. The sand-blasting and grinding will be treated in detail in a subsequent article.

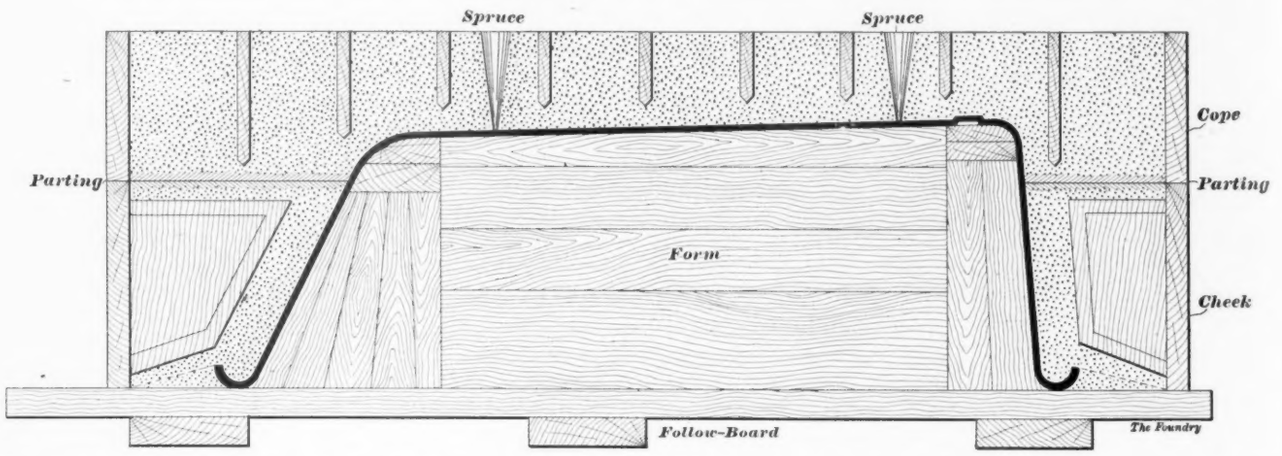


FIG. 3—LEAD PATTERN ON THE FORM AND FOLLOW-BOARD. THE FIRST MOLDING OPERATION INCLUDES THE RAMMING OF THE CHEEK AND COPE

Filing the Cast Iron Pattern.

We are now ready to file the cast iron pattern, and again we must consider whether it is to be used for a working pattern or a master pattern. If it is to be used as a master pattern, it must be carefully inspected, should be straight and symmetrical, and if not, a large amount of filing will be necessary. Considerable metal must be left for filing, as will be shown later. If a working pattern is desired, the casting should likewise be symmetrical and straight, but it is not necessary that it be quite as accurate as for a master pattern, nor is as much stock needed as for the latter. Holes are then drilled in the pattern as shown in Fig. 6. This is usually done with a small breast drill, using a flat drill inasmuch as the workmen employed on this work are unskilled and they are liable to be careless and break the drill by shifting the same quickly while drilling. These holes are drilled for the purpose of gaging the correct thickness of the pattern, and to facilitate this work and to insure accuracy, a gage is used shown in Figs. 8 and 9. The body of the tub is usually about ¼-inch thick, and in Fig. 8 the casting has been filed to the correct thickness, while in Fig. 9 the gage is located in one of these holes and shows the amount of metal to be removed. This thickness gage is usually made by the workman from a small piece of iron with a ring in one end and a flat slot, the thickness of the pattern, is filed near the other end of the gage. If the pattern is too thin it can readily be measured by this gage and in most cases the casting must be made over, as a pattern less than the required thickness cannot be tolerated. Occasionally the foundryman is compelled to increase the pattern to the proper thickness at

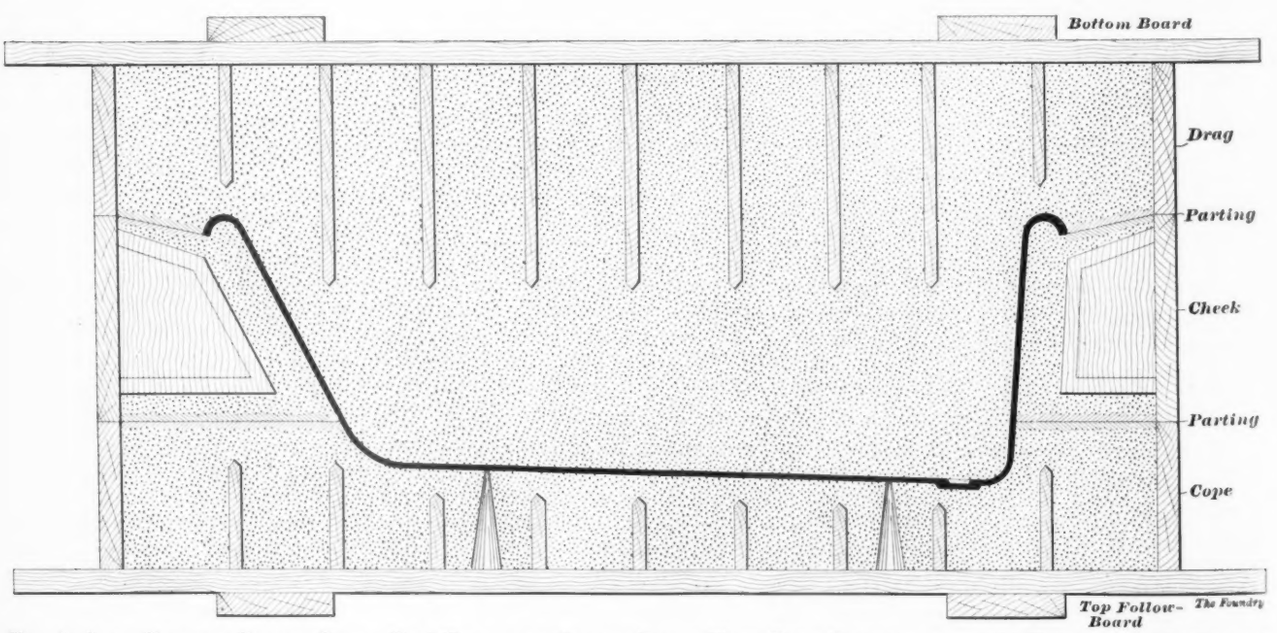


FIG. 4—LEAD PATTERN ROLLED OVER. THE FORM AND FOLLOW-BOARD HAVE BEEN REMOVED AND THE TOP FOLLOW-BOARD IS IN PLACE. THE DRAG HAS BEEN RAMMED AND THE BOTTOM BOARD IS IN PLACE READY TO ROLL OVER THE MOLD

certain points, and to accomplish this a piece of sheet brass is inlaid in the casting and is filed up to the proper thickness.

Grinding the Cast Iron Pattern.

To reduce the cost of filing, the cast iron patterns are ground by an abrasive wheel driven by a flexible shaft. A number of grades and shapes of wheels must be used so as to secure their full efficiency and to prevent grinding the pattern down too quickly when approaching the required thickness. The amount of metal removed by the operator using a grinder on the flexible shaft is indicated on a gage similar to that shown in Figs. 8 and 9, with the slot slightly longer and exceeding the required thickness of the pattern by 1/32 to 1/64-inch, this depending entirely upon the experience of the grinder. The operator must also use a small, straight edge so as not to grind in pockets. He must also be careful not to grind in one spot, as this is liable to spring the tub, as the friction will generate considerable heat and it is, therefore, necessary for him to swing the wheel constantly over a considerable area. If the motor is mounted on a pivoted platform so that it can swing easily, there is little danger of the flexible shaft breaking at the motor shaft joint, and the grinding can also be done more easily.

Hand Filing the Tub Pattern.

After the tub has been ground to the required thickness, the cast iron pattern is filed by hand to the finished thickness. This is a wearisome job as considerable metal is to be removed. The author has conducted a number of experiments to ascertain how much work a man should accomplish on these tubs, and after a day's work it was difficult to see where the metal had been removed. In order to find out how much metal is taken off from day to day, the patterns are weighed every morning. The amount of metal removed will vary from 2 to 4½ pounds for the first few days, whereas, on the last day, when the tub is being finished, only about ¾-pound of metal can be removed. Two sheet iron templates to which the rim must conform are shown in Fig. 10. Template A is fitted around the rim of the tub first and the lower edge is pressed snugly against the side of the tub. Template B is used in conjunction with A. In some cases however, template B is entirely dispensed with and the thickness of the tub is left entirely to the judgment of an experienced workman. This rim gage is used in all cases, both on the machine tub patterns, as well as on the ordinary hand molded tubs. It usually takes from a week to 10 days to file one of these patterns when two men are employed on the work. In order to level up the tubs around the rim, it is advisable to place them on a large surface plate mounted on legs. However, until the machine molded tub made the use of this large surface plate imperative, the usual method of lining up with straight edges and levels answered the purpose satisfactorily.

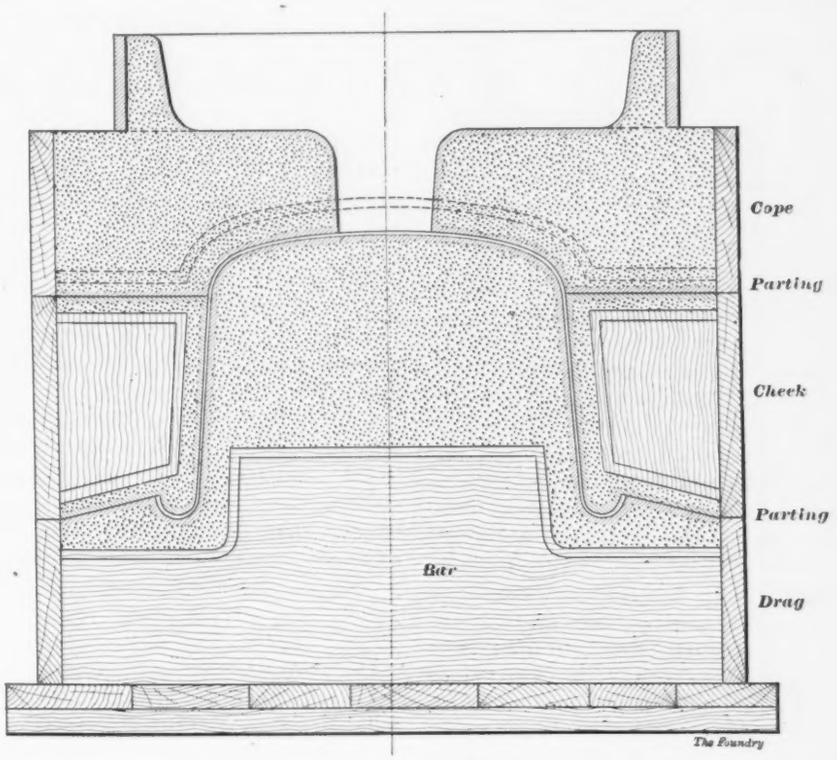


FIG. 5—SECTIONAL VIEW OF THE TUB MOLD READY TO POUR

CASTING STEAM FITTINGS.

"Conditions Governing the Production of Castings in Steam Metal Alloys," was the subject of an address recently delivered before the Birmingham (Eng.) Metallurgical Society by Percy Longmuir.

The lecturer spoke of the difficulty which every foundryman has experienced in obtaining castings of regular quality even when the mixture and other conditions were not known to have varied. Among the visible defects he mentioned the abrupt change of thickness of section. It was not an uncommon thing, especially in hydraulic castings, to see flanges, having a thickness out of all proportion to the valve body. In actual practice the junction, the most important part of the casting, is filleted, but as a rule such fillets are insignificant, and when left to the molder, are not always satisfactory. In such cases, there is certain to be

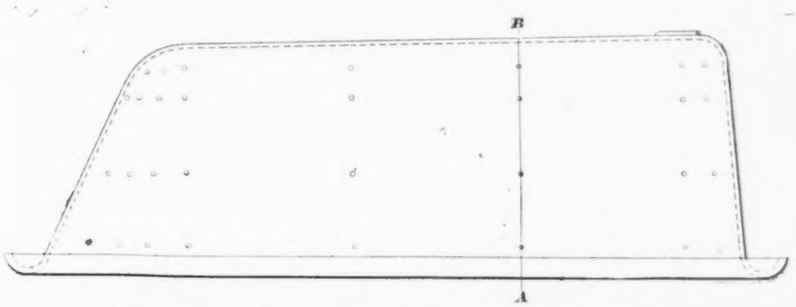


FIG. 6—HAND MOLDED TUB PATTERN DRILLED FOR FILING

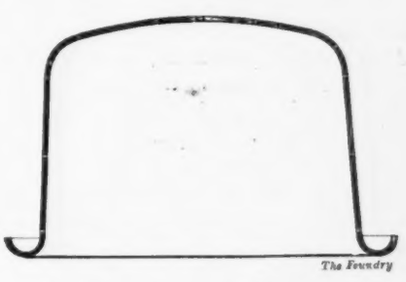


FIG. 7—SECTION A B, FIG. 6

a leak at the junction when tested by high pressure steam or water. Under certain conditions, the junction might be drawn into a series of fine holes around the circumference itself and would readily leak even when tested at ordinary water pressure. Such defects, he said, are always due to contraction. Apart from this, certain differences in the arrangement of crystals might follow, if during cooling, the crystal growth was caused to take a particular direction. This might result in planes of weakness. In square castings, for instance, as the crystals take their direction from the cooling surface, a disturbance might be found in the corners which were further weakened because the casting consisted of four planes, each tending to approach its own center.

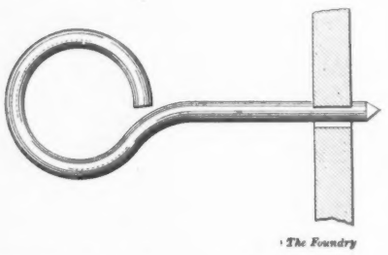


FIG. 8—GAGE SHOWING METAL FILED TO THE CORRECT THICKNESS

Contraction.

In dealing with alloys, he added, the most important question is that of crystallization. When some of the constituents solidify at a much lower temperature than the major body of the alloy, it often happens that an apparently solid casting contains minute globules of easily fusible metal. This contracts away from the surrounding solid body and leaves microscopically minute spaces, which might form routes giving rise to sweating. Taking a chemically pure copper, if even a minute percentage of impurity were added, that under certain conditions might be dissolved in the mass, but under other conditions might form a combination which would be rejected to the crystal boundaries of the copper, a casting in the form of an ordinary valve body would not be impervious even at ordinary city pressure. The water would leak through the inter-crystalline space. In the case of iron castings a minute percentage of sulphur might cause the formation of such spaces, while the actual sulphur itself would be extremely porous. Sharply defined crystal boundaries are not inimical to water-tightness if the crystals are dovetailed, or interwoven, well into each other. Such a metal would be tight under almost any conditions, but as a rule, when large and well-developed crystals occur the metal is weak.

Grain of Steam Metal.

The structure of a good, commercial steam metal should be interlocked. In other words, what the makers should aim at is what the practical man would call a fine grained metal and what the metallographist would call a fine structure. In other words, the producers of steam metal alloys should aim at a structure as nearly that of a forged material as possible. In the case of steel, some steam fittings were annealed to partly rearrange the crystalline structure and also to remove casting stresses. The lecturer suggested that while other steam metal materials were not usually treated, they would probably admit of annealing to advantage. At any rate, the point was certainly one worthy of investigation.

Tests.

The lecturer also drew attention to the close relation between the results of the steam and water tests as those given by mechanical tests as bearing upon the qualities of metals for steam and water purposes, and dwelt upon the importance of casting temperatures as affecting the qualities required. This he exemplified by the following tables:

Effect of Varying Casting Temperatures.

GRAY CAST IRON.

Casting temperature, degrees cent.	Tensile strength, tons per square inch.
1,400	9.7
1,350	14.1
1,245	10.6

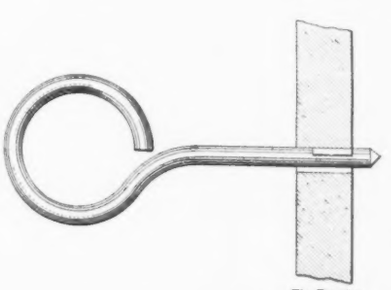


FIG. 9—THICKNESS GAGE SHOWING THE METAL TO BE REMOVED

MALLEABLE CAST IRON.

Casting temperature, degrees, Cent.	Tensile strength, tons per square inch as cast.	Tensile strength tons per square inch, heat treated.	Tensile strength, tons per square inch, annealed.
1,320	10.7	18.6	20.6
1,230	15.9	24.0	29.2
1,120	12.1	21.6	26.5

ANNEALED STEEL CASTINGS.

Tensile strength, tons per square inch.	Elongation, per cent.	Reduction of area, per cent
24.2	9.5	18.0
27.2	24.0	32.3
27.0	12.5	17.5
25.5	8.0	12.0

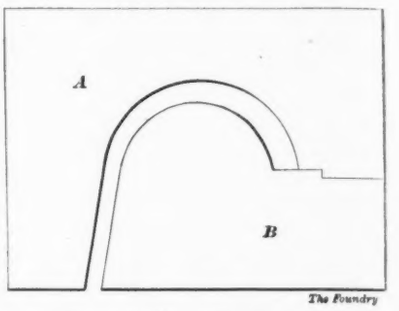


FIG. 10—RIM TEMPLATES

GUN METAL.

Casting temperature, degrees, Cent.	Tensile strength, tons per square inch.	Elongation, per cent.	Reduction of area, per cent.
1,173	8.4	5.5	4.2
1,069	14.8	14.5	16.7
965	11.0	5.0	6.3

YELLOW BRASS.

Casting temperature, degrees, Cent.	Tensile strength, tons per square inch.	Elongation, per cent.	Reduction of area, per cent.
1,182	11.5	37.7	31.4
1,020	12.7	43.0	35.6
.....	7.4	15.0	15.2

RED BRASS.

Casting temperature, degrees, Cent.	Tensile strength, tons per square inch.	Elongation, per cent.	Reduction of area, per cent.
1,308	6.8	13.2	12.6
1,073	12.6	26.0	30.2
1,058	5.6	5.5	6.6

MUNTZ METAL.

Casting temperature, degrees, Cent.	Tensile strength, tons per square inch.	Elongation, per cent.	Reduction of area, per cent.
1,038	12.4	6.0	10.6
973	18.9	15.0	16.1
943	16.2	9.5	14.8

ANNUAL MEETING OF THE MILWAUKEE FOUNDRY FOREMEN.

The annual meeting and banquet of the Milwaukee Foundrymen's Association was held at the St. Charles Hotel, April 6. Officers for the ensuing year were elected as follows: Henry Biegle, president; George Klink, vice president; J. L. Marshall, secretary and H. Paulus, treasurer.

The Shanafelt Mfg. Co., Canton, O., manufacturer of pattern shop and foundry supplies, is building a two-story brick extension to its plant, 44 x 62 feet. It will be equipped with machinery for the manufacture of new lines of supplies that will be made for the pattern shop and foundry trade. Notwithstanding the lull in the foundry business this concern has experienced a constantly increasing demand for its products and the volume of business last year showed a big gain over 1907.

BRASS VALVE CORE SHOP PRACTICE

Including a description of the highly specialized molding methods pursued in the manufacture of brass valves, lubricators, etc.

THE Detroit Lubricator Co., Detroit, has so systematized its foundry work that the cost of producing the large number of castings required in the manufacture of the lubricators, valves and other specialties manufactured, has been reduced to the lowest possible limit. The castings, which are of brass, are mostly small and their number runs into thousands daily. The high efficiency attained in the foundry is due not only to careful pattern and core making, and the accurate mounting of patterns on the match plates, but also to the specializing of each operation so far as possible in the making and pouring of the mold. Practically all of the molds are made on molding machines, the bench work being limited to experimental jobs. The molding machines comprise both the Berkshire and Tabor types and metal flasks and patterns are used exclusively. The general arrangement of the foundry is shown in Fig. 1, while Fig. 2 illustrates the two Berkshire molding machines employed. It will be noted that in the foreground is a table built roughly in the shape of a tee. This table plays an important part in the rapid production of molds and its use will be briefly discussed. At each Berkshire machine works a machine operator and two helpers. As fast as the molds are turned out by the machine, they are removed by one of the helpers and placed on that part of the table forming the leg of the tee. A man stationed at the table dusts the mold with parting sand and blows the surplus sand off by means of the air hose shown suspended over the table. He then pushes the mold along to the cross of the tee, whence it is lifted to the pouring stands shown in the foreground of Fig. 2 and more clearly in Fig. 1. These stands are built of angles and are set at such a level as to bring the molds at the proper height and angle for pouring.

The labor in the foundry is all specialized. The man whose duty it is to place the molds on the stands does nothing else. Another man sets the cores in the molds. All the drags are placed on one stand and the core setter sets the cores while the man whose duty it is to place the molds is filling another stand with drags or placing the copes on molds in which the cores have already been set. After the molds are closed, a pouring gang, that is working continuously, and that does nothing else, pours the molds. As soon as they are sufficiently cooled, a second gang removes the molds to one end of the foundry where they are shaken out and the castings removed to the cleaning room, while the sand is cut over, tempered and fed into conveying machinery, which delivers it to the molding machines. The cleaning equipment comprises cutting-off shears and hand grinders installed in one end of the foundry, a sand blast tumbling apparatus in a separate room, and several wet tumbling barrels in the foundry.

FIG. 1—GENERAL VIEW OF THE DETROIT LUBRICATOR CO.'S BRASS FOUNDRY

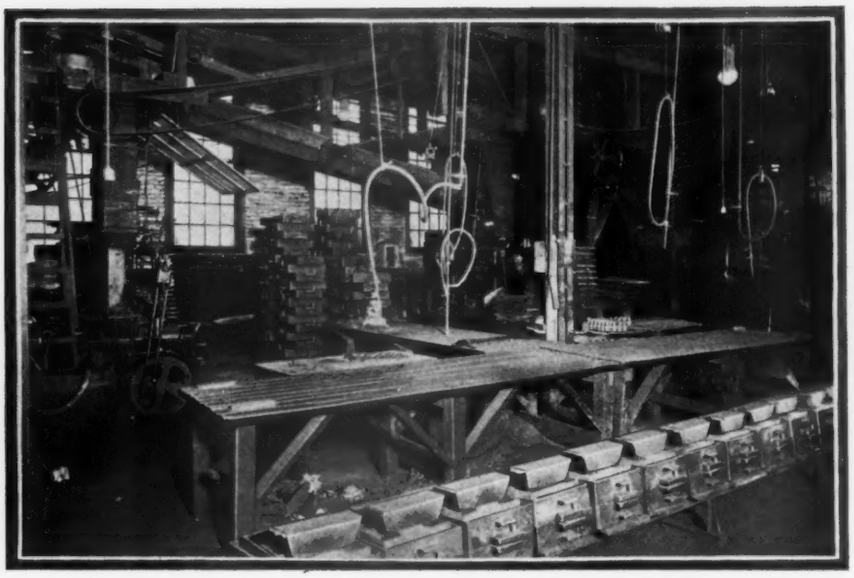


FIG. 2—IN THE BACKGROUND ARE SHOWN TWO BERKSHIRE AUTOMATIC MOLDING MACHINES, AND IN THE FOREGROUND IS THE TABLE ON WHICH THE MOLDS ARE CLOSED

The melting equipment comprises four Schwartz melting furnaces, one Fisher furnace and four ordinary pit crucible furnaces. These are situated in a lean-to adjacent to the foundry and separated therefrom by a brick and steel wall, which keeps the fumes away from the molders and other workmen so far as possible. A ventilating fan blows a current of fresh air across the melting furnaces and renders the atmosphere in the melting room as pure as possible under the conditions.

An important department of the foundry is the core room, which immediately adjoins it at one end. This is a large, well-arranged and well-lighted room, as shown by the illustration, Fig. 4. The core work is of the most interesting character and evidences the great care and forethought which has been exercised in every department of the works to facilitate large production at low cost. Figs. 8, 9 and 10 are typical core boxes and will be described in considerable detail.

Core Boxes for Intricate Work.

The core box shown in Fig. 6 is for a core to form an internal thread in a cylindrical surface. As shown in the illustration, the core box proper is made in four parts, each comprising one quadrant of the cylindrical section. The sleeve shown at the left fits over the upper portion of the core box and binds them firmly together. In making the core, the sand is rammed in from either end and the core box is then placed on a flat surface. The sleeve is lifted off and the four portions of the core box are withdrawn radially from the core. A core box of a somewhat similar character is shown in Fig. 10. This core consists of a cylindrical portion with cylindrical projections or lugs extending radially around it near the top. As is plainly shown in the illustration, the core box is made in two parts divided along the center line of the projecting lugs. Dowel pins in the upper portions insure the two parts coming together in their proper relation. The ring shown at the left is slipped down over the junction of the upper and lower parts of the core box, seating itself against the shoulder on the lower part of the core box. Sand is then rammed in through the bottom of the core box and through the holes in the sides to form the projecting lug. The ring is then removed, together with the cap and the lower half of the box is drawn vertically upwards from the core, which has, in the meantime, been inverted on a plate.

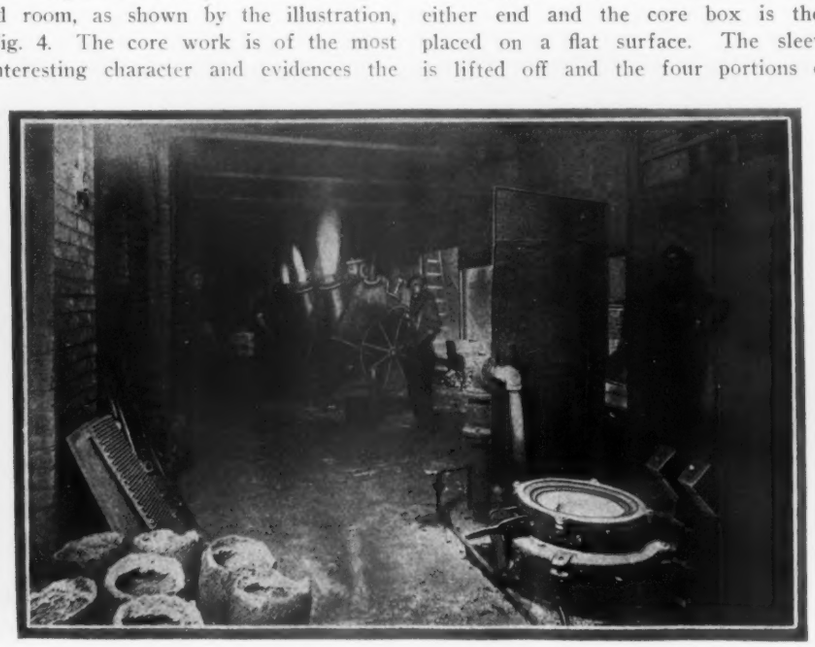


FIG. 3—THE MELTING DEPARTMENT

Core Box for Sight Feed Lubricator Core.

A very interesting core box is the one for the core of a steam-engine, sight feed lubricator shown in Fig. 8. This box is constructed on the principle of a loose piece pattern and facilitates the making, in a rather simple manner, of a core, which might otherwise present some difficulties. The loose pieces are those forming holes in the core and project into it in such a manner that it would be difficult or impossible to make the core in one piece by any other arrangement. In operation, the sand is rammed into the core box in the usual manner. The box is then turned over on a flat plate and lifted off from the core. The loose pieces, which are dowelled into the box are then slid out sideways from beneath the core. Two portions of this core are then glued together after drying to form the core for the mold.

A core box for the core of a locomotive, sight feed lubricator, is shown in Fig. 9. This box has a number of interesting features. The two ribs extending across the face of the two halves of the box form a loose piece. The pin extending down the center of the lower box forms another loose piece and serves the purpose of forming a vertical hole in the core. It is held in place by a pin extending through it and screws into the boss at about the middle of the core box. This pin is attached to and operated by the knob at the top of the core box. The box for the opposite half of the core is shown in the upper portion of the illustration. The method of making the

core is quite apparent, the sand being rammed in the usual fashion, the pin unscrewed and the rod forming the hole through the center of the core is withdrawn vertically, the loose piece is lifted out and the core box is lifted vertically from the core.

Venting the Core.

A very interesting feature of this core box is the method of venting the core. A hole will be noticed slightly below the edge on either side of both pieces of the core box. Through these holes a stout wire is threaded, which forms the main vent of the core. Other vent wires are laid across the core at appropriate intervals to form auxiliary vents and these are connected to the main vent by pricking down through the core. Another type of core in which an interesting method is used for venting is that for elbow-shaped pieces. In connection with the core box is used a flat plate on which is a ridge running along the center of the core, the position of the ridge in relation to the core box being determined by dowel pins in the core box. After the core box has been rammed, the plate is slipped over the dowel pins and pressed against the core, forming a channel through it. These particular cores are made in halves and when the two halves are matched together the vent channel is exactly in the middle of the core and extends from end to end.

Method of Printing the Cores.

All cores are so made that it is impossible to place them in the molds in an incorrect position. Either the core prints are made of different sizes on the two ends, and where a core may be placed improperly in a mold, as regards its left or right hand side, an index is made on the core, which fits into an appropriate core print, preventing it from being placed in the mold in any but the correct position.

Match Plates.

The patterns, in many cases, are mounted so that the cope and drag are made from the same match plate. An instance of this is shown in the pattern at the right of Fig. 7. As work of this character necessitates extremely accurate mounting of the patterns, a description of the method pursued may prove of interest. The first consideration is to see that the two halves of a given pattern match without offsets or overlapping edges. The position of the holes by which the patterns are screwed to the match plate are determined and drilled in one-half of the pattern, which is then used as a jig for drilling the opposite half. These

FIG. 4—THE LARGE, WELL-ARRANGED AND WELL-LIGHTED CORE ROOM

two halves are then used as jigs for drilling all other patterns, which are to be mounted on the same plate. The position of the patterns is determined on the plate and the first half pattern, or master pattern, is used as a jig for drilling the screw holes in a brass master plate. This brass master plate is provided with ears similar to and in the same position as those on the match plate in which are the holes for securing the match plate to the flask in the foundry. The brass master plate is accurately divided in two equal parts by a line through its center and the patterns are positioned on one side of this line only. The brass master plate is then used as a jig for drilling the holes on one side of the match plate, being secured to it in its proper relation by means of paper pins driven through the holes in the ears on both plates. After the holes on one side of the plate are drilled the brass master plate is turned over and used as a jig for drilling the holes in the opposite half of the match plate. The holes are laid out on the master plate by means of a center punch, the exact diameter of the holes in the pattern, the center punch being dropped through the holes, which have already been drilled in the pattern. With ordinary care this method insures an absolute match of the cope and drag portions of the mold.

FIG. 5—PATTERN STORAGE SHOWING SHELVES FOR STORING PATTERN PLATES FOR MOLDING MACHINE USE

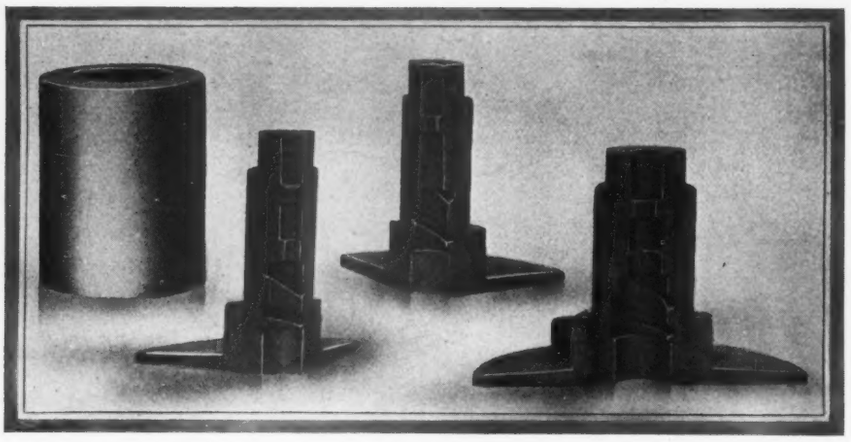


FIG. 6—CORE BOX FOR CORE THAT FORMS AN INTERNAL THREAD IN A CYLINDRICAL SURFACE

The system of storing patterns is shown in Fig. 5. Vertical racks are used, each being numbered to correspond to the number of the patterns. The patterns after use in the foundry are slipped into unnumbered racks in one side of the store room from which they are removed and sent to the pattern shop. They are there inspected for accuracy and such repairs as may be necessary on them are made. They are then returned to the storage and placed in the proper rack, from which they may be withdrawn for use in the foundry.

Mill for Recovering Brass.

An interesting adjunct to the foundry is shown in Fig. 11. This consists of a mill, in which all the brass particles that remain in the foundry sand are recovered. As seen in the illustration it comprises a form of tumbling barrel, into which the burnt sand is introduced, being subject to the impact of a heavy ball on the interior while being revolved. The sand and brass particles are pulverized and the sand is flushed out by a copious stream of water which flows continuously through the mill. The brass particles being heavier, sink to the bottom of the mill, and are recovered for remelting in the furnaces.

TRADE NOTES.

The Foundry Specialty Co., Cincinnati, is now manufacturing a new flux for use in brass foundries, which is known by the trade name of "Fluxine." It is claimed that it will save from 5 to 7 per cent of metal that is usually lost in the melting process, and it is unusually valuable for removing the impurities from old material when used exclusively in the mixture. The manufacturer also claims that this flux will prevent oxidation and blow holes, increases the tensile strength of the metal and in no way injures the crucible.

The J. D. Smith Foundry Supply Co., Cleveland, has increased its capital stock from $50,000 to $100,000. The increase is to provide capital for this concern's constantly expanding business, and no additions to the plant are contemplated.

The American Manganese Bronze Co., manufacturer of Spare's manganese, white and hydraulic bronzes, has removed its main office to its works at Holmesburg, Philadelphia. The office at 99 John street, New York, will be maintained as a branch sales office.

The March number of the Obermayer bulletin contains a number of interesting articles relating to practical foundry work. The subject of core making and the use of core compounds are discussed at length and Paul R. Ramp gives some practical hints on the use of steel core coating.

G. H. Hooper, foundry engineer, has announced the removal of his office to the City Investing Building, 165 Broadway, New York.

The Philadelphia Chaplet & Mfg. Co. is a concern recently incorporated in that city to manufacture chaplets and anchors for foundry use. The president and general manager of the company is John P. McCoy, for a number of years with the Baldwin Locomotive Works, and J. I. Fasy is general sales manager. The company has secured a new plant located at

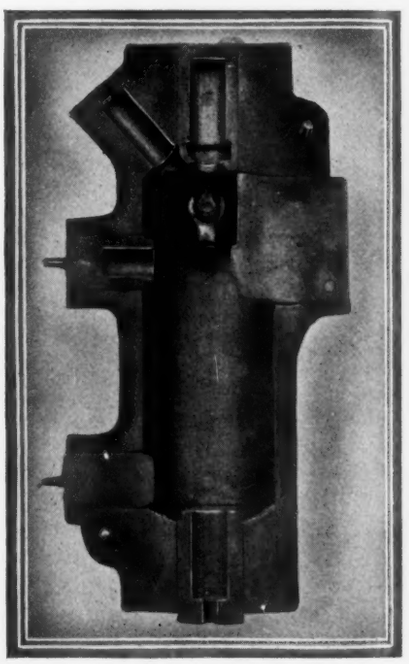


FIG. 8—CORE BOX FOR SIGHT FEED LUBRICATOR CORE

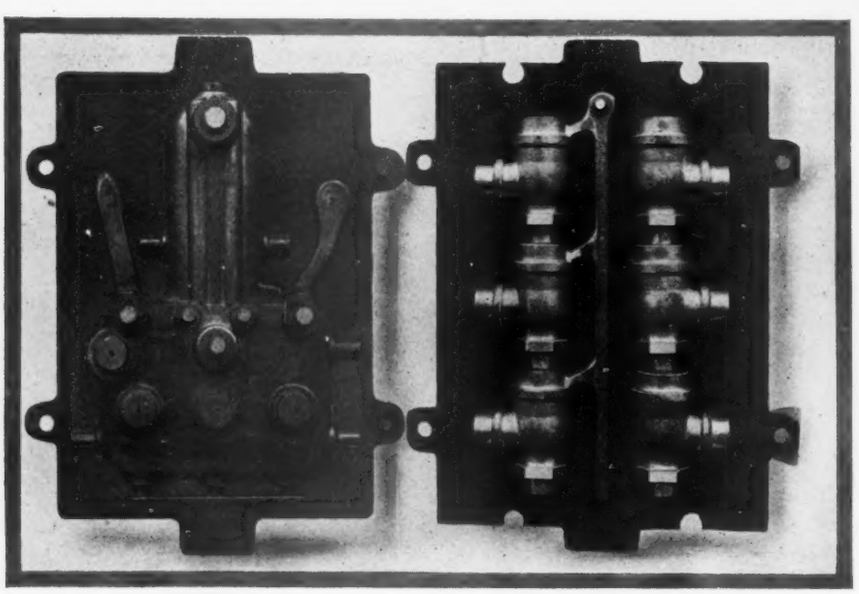


FIG. 7—MATCH PLATES USED ON THE MOLDING MACHINE

School Lane and the P. & R. Railway, and has equipped it with automatic machinery for the manufacture of these products, which will be known by the trade name of "Philadelphia Patented Chaplets and Anchors." The plant will be operated under the personal supervision of Mr. McCoy.

The Milwaukee Correspondence School, Goldsmith building, Milwaukee, Wis., has issued a four-page circular containing testimonial letters from foundry foremen who have derived great benefits from the correspondence course offered by this school.

The Northern Engineering Works, Detroit, reports recent shipments of Newten cupolas with hourly capacities as follows: Quinn Iron Works, four

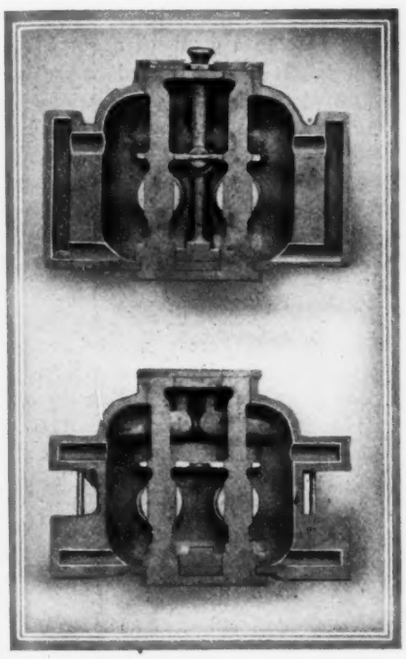


FIG. 9—CORE BOX FOR A LOCOMOTIVE SIGHT FEED LUBRICATOR CORE

tons; Sheridan Stove Co., Quincy, Ill., 12 tons; Crown Mfg. Co., four tons; Wagner Bros., five tons; Wm. Fetzer & Co., Springfield, Ill., ten tons. The Southern Wisconsin Foundry Co., Madison, Wis., also recently installed a ten-ton Northern crane, having a 50-foot span.

The J. W. Paxson Co., Philadelphia, has decided to establish a branch office and warehouse in which a complete line of foundry supplies and equipment will be carried, at Toledo, O. This warehouse will be under the direction of L. A. Crandall, and will be opened for business about June 1.

The Colonial Brush & Mfg. Co., Milwaukee, announces the purchase of the Hendee Wire Brass Co. and the Hendee-Katz Brush Co. of the same place. Foundry brushes of all kinds are manufactured.

The Whiting Foundry Equipment Co., Harvey, Ill., announces the appointment of L. G. Henes, located in the Monadnock building, San Francisco as its California, Nevada and Arizona representative for cranes and foundry equipment.

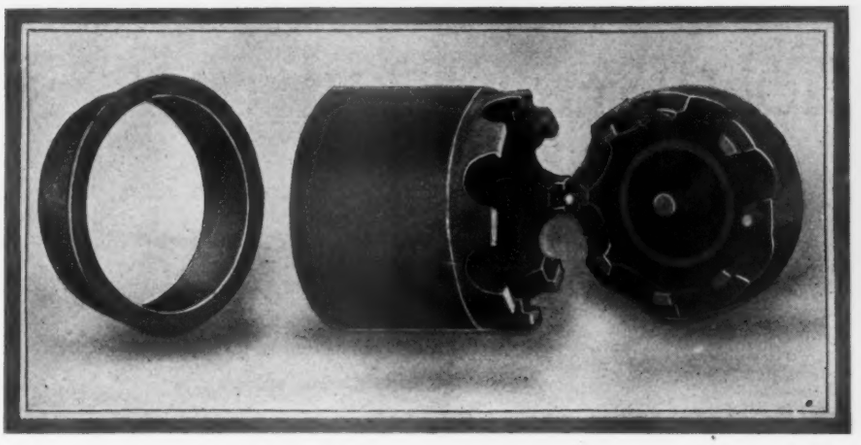


FIG. 10—CORE BOX FOR A DIFFICULT CYLINDRICAL CORE

LARGE CASTINGS FROM A SMALL CUPOLA.

BY W. J. KEEP

Question:—Our cupola is lined to 26 inches and the bottoms of the tuyeres are about 12 inches above the bed. We want to make a casting weighing about 3,500 pounds and would like to know whether we can satisfactorily melt and accumulate this amount of molten iron?

Answer:—It depends entirely upon what kind of a casting you wish to make. Your tuyeres are too close to the bottom to tap out more than 500 pounds of iron at a time, and it would probably take one hour to melt 3,500 pounds, which if held in a ladle would be too dull to run anything but an anvil block.

HIGH OR LOW BLAST PRESSURES.

W. J. KEEP

Question:—We are using a positive pressure blower and our blast is five or six ounces. We find that if we increase this to any extent we cool the iron considerably. Is this caused by the increase of pressure?

Answer:—If you burn sufficient coke your iron will be hot. The faster the coke is burned the faster the iron will melt. The only way to burn the coke rapidly is to blow in more air. The blast pressure should be about 14 ounces, and if you have sufficient coke in the cupola an increase to 18 ounces will not cool the iron. Your trouble undoubtedly lies in your method of charging.

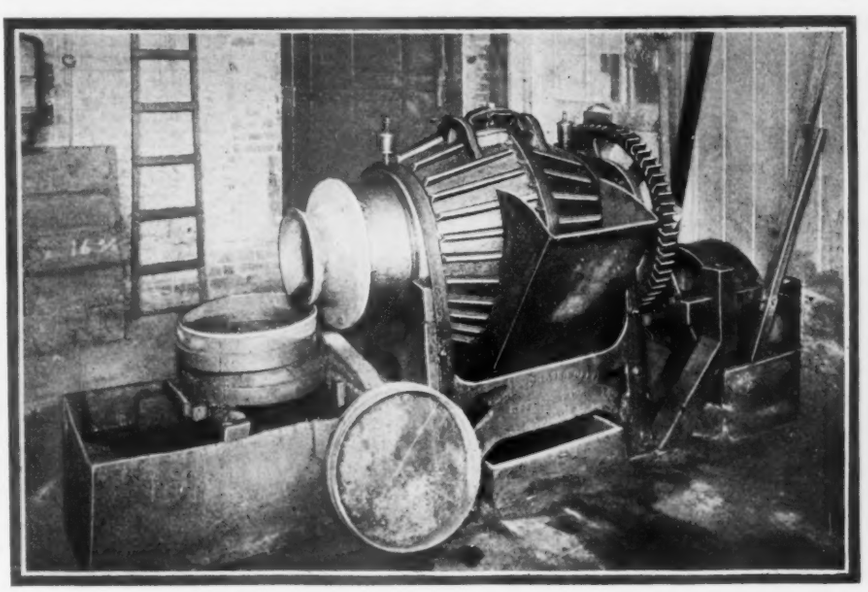


FIG. 11—WATER MILL FOR THE RECOVERY OF BRASS FROM THE BURNT, FOUNDRY SAND

MOLDING LARGE CAST STEEL SWIVELS

By the use of dry sand cores the links are cast around the hooks---Multiple molding

BY H. J. McCASLIN

A CAST steel job, somewhat out of the ordinary owing to the intercasting of two separate parts in such a way as to permit of a freely rotating connection between them, is shown in Fig. 1. While small swivels or similar castings are frequently made of malleable iron, it is doubtful whether the manufacture of these sections in steel has previously been attempted. However, the principle involved in producing them of malleable iron was found to apply very satisfactorily to steel.

The casting was a swivel of rather large proportions having an overall dimension of about nine inches. While steel castings cannot always be substituted for forgings, in some cases they will answer the purpose very well, and when a large number is required they can be produced at a much lower cost. The hook of the swivel is cast first, and is so arranged within a dry sand core that the link may be cast around it. As the core box, shown in Fig. 2, is made so that the hook casting, shown in Fig. 4, will fit the core snugly, several of these castings are made that their average variation may be determined and the core box made accordingly. They are molded from an ordinary pattern in the usual way.

That the head of the hook may be as true to pattern as possible to permit of a free rotation, any shift in the flask should be carefully avoided. As the link is symmetrical about its center, only a few patterns will be required for the core box, two views of which are shown in Fig. 3. Such, however, is not the case with the pieces X which form the depression in the core in which the hook casting is placed. As the two halves of the core which are subsequently pasted together are made from this box, right and left hand pieces must be made and pinned in place as shown. Provision must also be made for shifting the vent pin Y and gate Z to the opposite side, as shown in the dotted lines. Fig. 2 shows a half plan and cross section of the assembled mold, as well as a half plan on the joint of the cores.

In addition to the cores, the hook castings require considerable attention. To provide sufficient clearance when cast, and to prevent that portion of the hook from coming in contact with the hot metal, which is cast around it, a coating of silica sand is applied. The hook is then dipped in raw linseed oil to the proper depth as shown at E, Fig. 4. Silica sand is then sprinkled over it and it will adhere to a depth of about 1/32 of an inch. It is then placed in the oven and dried, and if a heavier coating is desired, this operation may be repeated until the proper thickness is obtained. Before the silica sand is applied, however, all rough parts of the hook should be carefully filed, as they might interfere with the rotating movement after the swivel has been cast.

If a large number of these castings are to be made the cross can be arranged on the multiple plan, as shown in Fig. 5. The gates are placed so that the cores may be grouped together and stacked upon each other in such a way that the same runner will serve all the molds. To hold a group of cores intact, when subjected to the flow of metal, they may be rammed in a flask or curb.

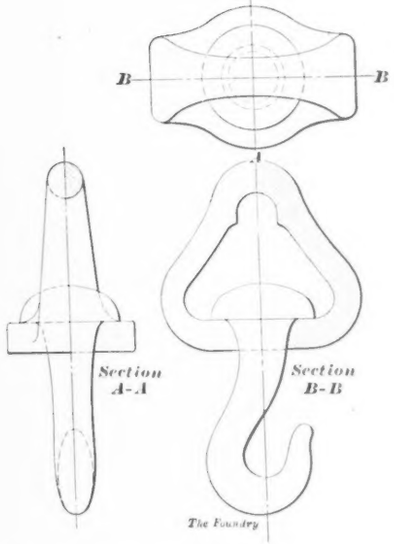


FIG. 1—PLAN AND SECTIONAL VIEWS OF THE CAST STEEL SWIVEL

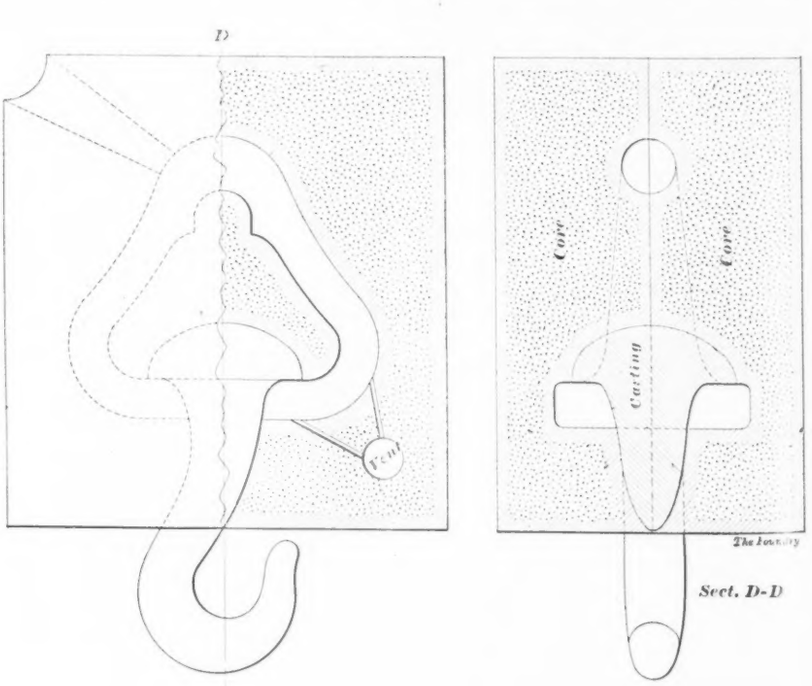


FIG. 2—HALF PLAN AND CROSS SECTION OF SWIVEL MOLD

MANGANESE BRONZE.

Question:—The mixture we are using consists of copper 63, zinc 36 and lead 1. I would like to know how much copper, manganese and aluminum would have to be added to this mixture to make a good manganese bronze which we can use for cut gears. If the mixture named is not satisfactory we would like to have another that has given good results, as well as a good yellow brass mixture for the work outlined.

Answer:—It would be difficult to make a good manganese bronze from the mixture given as the use of lead in manganese bronze is out of the question. In fact very few brass foundries can make a good manganese bronze, as this metal is the most difficult alloy made. It contains a half-dozen different metals and metalloids, which require great skill in melting and mixing. A very good, reliable alloy, however, is made as follows: Copper, 53 pounds, manganese copper 5 pounds, zinc 36 pounds, tin 8 ounces, aluminum 5 ounces, iron 5 ounces. For yellow brass try, copper 10 pounds, zinc 4 pounds, tin 4 ounces, and lead 6 ounces. K. K.

LIMESTONE AS A CUPOLA FLUX.

By W. J. Keep

Question:—We note in a recent issue of THE FOUNDRY the statement that limestone should average about 80 per cent lime. We recently had an analysis made of our limestone which follows: Silica, 1.34 per cent; oxides of iron and alumina, 0.84 per cent; lime, 40.86 per cent, magnesia 12.28 per cent and loss by ignition, 46.68 per cent. This stone can be secured from a quarry near our

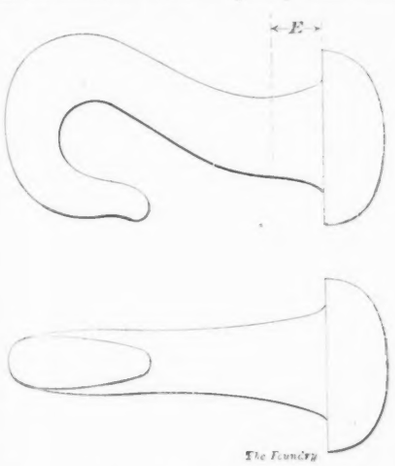


Fig. 4—Hook Section of the Swivel

plant and we would like to know whether this lime is desirable as a flux for our cupola. How much should we use with a charge of 2,800 pounds of iron? Our mixture contains 2.40 to 2.50 per cent of silicon and is used for light machinery castings.

Answer:—This cannot be called a limestone, but is dolomite, which is unsuited for your work. If this stone was taken out of the quarry considerably below the surface it is probable that the limestone nearer the surface will contain a higher percentage of lime. The limestone which projects from the surface of the ground and has been exposed to the weather, is generally high in lime and white in color instead of blue. The lime is the only part of the stone that does any good as a flux, and in addition you are compelled to melt the other 59 per cent which does not assist you in removing the impurities. Inasmuch as you are located near the marble quarries you might try the small pieces that are ordinarily thrown away. I think that you would find burnt lime cheaper than the stone you are using. You require about 20 pounds of lime to a ton of iron melted. To get this you must use too much of the stone that is mined near your shop. The fuel required to melt the impurities in your limestone in one heat would probably pay the freight on a carload of good limestone from a nearby point.

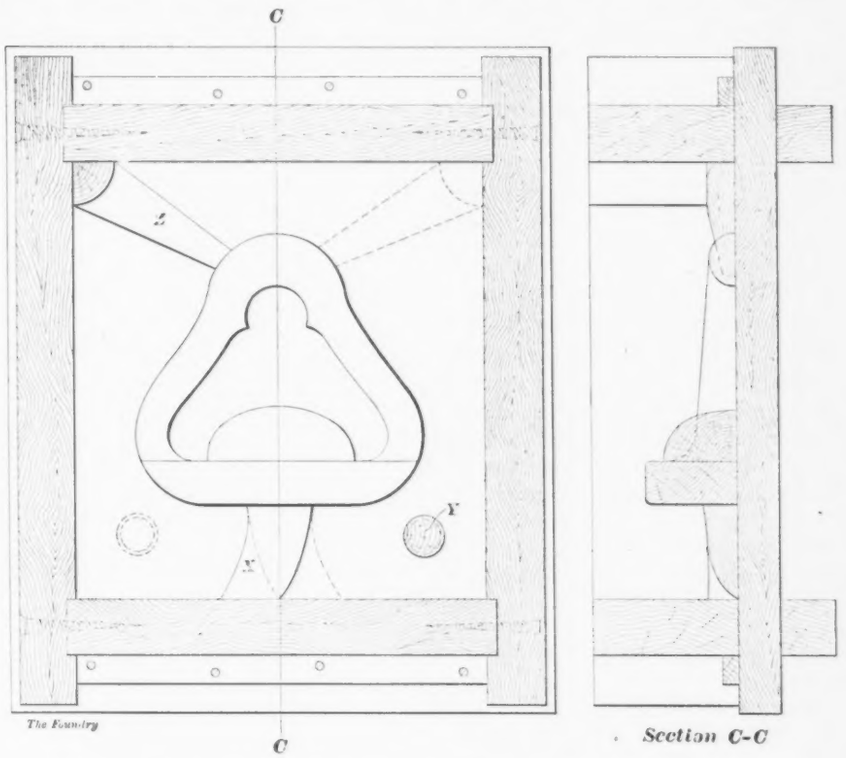


Fig. 3—Plan and Sectional Views of the Core Box

SAMPLING PIG IRON FOR ANALYSIS

BY C. H. FARLEY

THE mixing of iron by analysis has already largely superseded the old method of grading by fracture and mixing the iron by the grades thus determined, and even those foundries whose output will not warrant the employment of a chemist, are availing themselves of the services of a consulting chemist and a central laboratory. The foundry chemist has fully demonstrated that he can produce the iron best suited for a given class of work, which carries a great deal of weight with the prospective purchaser whose requirements may extend over a long period.

Sampling the Pig Iron.

This has led many foundrymen to attempt mixing iron by analysis in their own foundries. Following the chemist's procedure, the foundryman drills into 10 or 12 pigs, sends the samples to the laboratory for analysis, and makes his

mixture accordingly. The resulting iron may be too hard to machine or too soft for the best wearing qualities and mixing by analysis receives a setback as far as this particular foundry is concerned. Possibly the results are not so extreme, and he may decide to send the iron to the laboratory to ascertain whether it is possible to hold a mixture to closely defined limits. The laboratory reports an analysis radically different from what he had estimated it to be and he decides that the results are too uncertain to warrant adopting the newer method.

Wrong Method of Sampling.

It is not the method which is at fault but only the foundryman's lack of knowledge of the proper manner of taking a sample from either the pig iron or the casting. If the laboratory is to be of any assistance to the foundryman he must be certain that the small portion analyzed is truly representative of the lot of iron sampled. If I intended to purchase a share in a mine I would not permit the owner to select a small portion from the richest vein, and base his price for the mine on that one assay, neither would I be permitted to select a sample from the poorest vein and expect to purchase the mine at a price based on that sample. A piece of pig iron, and to a lesser extent, any part of a casting, may be considered as a vein of ore, with portions rich in one element and others correspondingly poor in that same element, and it is evident that any analysis made should be of that portion which will give the average percentage of the element contained in the iron. In order to know what portions should be used it is necessary to learn something of the segregation of the metalloids commonly found in cast iron, in other words, silicon, manganese, sulphur, and phosphorus.

	Silicon, per cent.	Manganese, per cent.	Sulphur, per cent.	Phosphorus, per cent.	Silicon, per cent.	Manganese, per cent.	Sulphur, per cent.	Phosphorus, per cent.
		No. 1.				Averages		
(a)	1.43	0.99	0.102	0.94				
(b)	1.44	0.98	0.099	0.87	1.45	0.98	0.103	0.85
(c)	1.48	0.98	0.108	0.74				
		No. 2.						
(a)	1.39	0.99	0.103	0.94				
(b)	1.40	0.98	0.099	0.91	1.40	0.98	0.102	0.90
(c)	1.42	0.98	0.104	0.86				
		No. 3.						
(a)	1.42	0.98	0.100	0.94				
(b)	1.42	0.99	0.101	0.90	1.43	0.98	0.100	0.91
(c)	1.44	0.98	0.099	0.90				

From another bar the following results were obtained:

	Silicon, per cent.	Manganese, per cent.	Sulphur, per cent.	Phosphorus, per cent.
Upper end	1.27	1.08	0.137	0.71
Middle	1.31	1.09	0.128	0.73
Lower end	1.43	1.09	0.116	0.73

FIG. 5—CORES ARRANGED ON THE MULTIPLE PLAN

Segregation of Metalloids.

These elements will segregate to a greater extent if allowed a relatively longer time before the iron sets, and to ascertain this in ordinary cast iron, the following investigation was carried out, the results of which are shown in the accompanying tables.

A bar 3 inches square and 3 feet long was cast on end and analyses made of various portions taken at different heights and at varying depths.

Lot No. 1 was taken 6 inches from the upper end, portion a comprising the drillings from the surface to ½ inch in depth; b comprised the drillings from ½ inch to 1 inch, and portion c from 1 inch to 1½ inches. As three holes were drilled on each side of the bar, c contained the iron from the center of the bar. Lot No. 2 was taken 18 inches from either end and lot No. 3 at 4½ inches from the bottom; portions a, b, and c, in lots 2 and 3 correspond with those in lot No. 1.

Drilling the Casting.

From the above analyses it is evident that any test bar or riser from a casting, such as a locomotive cylinder, should be drilled either completely through or only half through, particularly if the phosphorus content is of any importance, and about equidistant from the ends if the bar is more than 12 inches long.

These differences, due to segregation, although pronounced, are not great enough to cause trouble in the general run of foundry work which has an average section of about 1 inch, but it may, and very often does, cause trouble between the foundryman and the pig iron salesman. When sampling pig iron, break 10 pigs to the carload and take the drillings from the center of the freshly broken end and your sample will then be fairly representative of the carload, as it has been found that the sulphur decreases from the top to the bottom of the pig and the silicon increases, and as these two elements are the most essential, a sample taken from the middle will be the most satisfactory. If there should be an excessive amount

of sulphur present it will often be manifested by close grained "sulphur spots" and it would obviously be unfair to take all of the drillings from one of these spots if it occurred in the center or, on the other hand, to entirely avoid it, if at one side. The proper manner to sample such a piece of pig iron is to drill three holes, one in the center and two opposite corners, top and bottom, but do not make the mistake of using the combined drillings from this pig with only one-third as much from each of the others.

It is also advisable to use drillings from some of the sows, the proportion of sows to pigs being determined by a careful examination of the pile of pig iron.

In mixing iron by analysis, fully 75 per cent of the responsibility rests upon the man who takes the sample and only 25 per cent on the man who performs the actual analytical work, and if the foundryman would exercise more care in sampling his coke and pig iron, the results would be more satisfactory and fewer controversies would arise between the foundryman and the supply man.

As a very good example of the gross errors which may arise from improper sampling, the following may be cited. It had been customary to sample the locomotive cylinders cast each day by taking drillings from a riser attached to the casting, and very uniform results had been obtained. During the absence of the regular chemist another man procured the riser and forwarded the sample to the laboratory, which made the following report: Silicon, 1.56 per cent; manganese, 1.72 per cent; sulphur, 0.561 per cent; phosphorus, 0.54 per cent; whereas the cylinder should have had the following composition: Silicon, 1.20 per cent; manganese, 0.75 per cent; sulphur, 0.110 per cent; phosphorus, 0.50 per cent. Needless to say an investigation was immediately started which disclosed the fact that the sample had been obtained from a churned riser. A fair knowledge of the laws of segregation will make any such mistakes impossible.

THE USE AND APPLICATION OF PYROMETERS IN FOUNDRY WORK

BY CHARLES E. FOSTER

IN FOUNDRY work the successful production of the finished castings will generally depend upon the regulation of four main factors:

1—Composition of the material melted.

2—Atmosphere and surroundings.

3—Temperature.

4—Time.

Unless all of these important factors are accurately controlled, the operation must involve a considerable element of chance, and certainty of production cannot be attained. The strength of a chain is the strength of its weakest link; and the failure of one of the above four elements may render useless all the care spent upon the other conditions. Studying the list above, we see that classes 1 and 2 are controlled by the chemist and his assistant; 1 involves the proper weighing and correct mixture of the charge, while 2 includes such matters as slag, flux, lining of furnace, method of heating, material and facing of molds and cores, and later the packing material in the case of annealing. Classes 3 and 4 are dealt with in pyrometry. Information on 3 is gained from an indicating pyrometer and on 4 with a recording instrument. It is only by employing a recorder that full knowledge may be had in such cases as core baking and the annealing of castings. In each of these cases the time element is of great importance.

Temperature Record.

Turning for a moment to an illustration, Fig. 1 is a case in point. Here is a record showing the variations in temperature in a furnace used to anneal steel castings, the reproduction being on a reduced scale with some of the fine divisions omitted. It is evident that readings taken every hour would furnish no true account of what had been the temperature range. To again emphasize what has already been stated, no certainty of success can be had unless all four of the variable factors can be controlled.

When studying foundry practice from a position which is more or less that of an outsider, one of the most striking facts is the heavy percentage of losses incurred in general industrial work. The statement is advanced with great hesitation and is subject to correction, but it appears that the percentage of losses is larger than that endured in any other manufacturing operation of comparable magnitude.

The causes for this state of affairs are probably threefold. First, the inherent difficulty of casting operations; second, the antiquity of the industry and last the facts that in periods of great output there was no time to reorganize methods while, on the

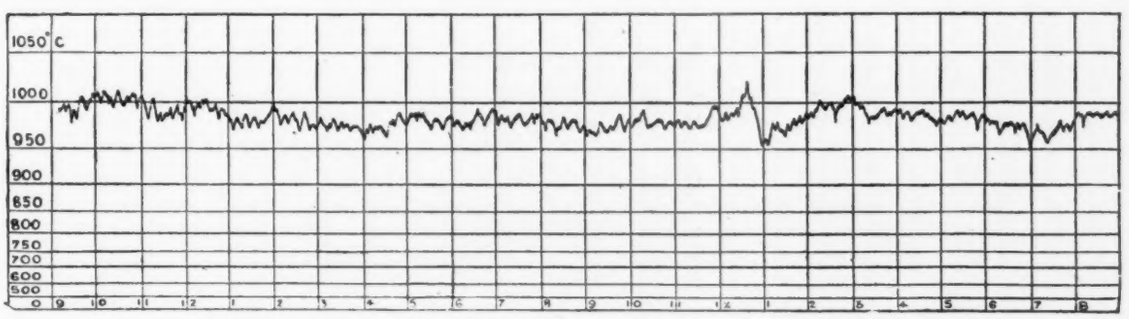


FIG. 1—TEMPERATURE RECORD OF STEEL CASTING ANNEALING FURNACE

other hand, in slack periods the general lethargy tended to prevent improvements.

When a bad lot of castings is produced the first information needed is, which of the four variables was at fault? Without definite information under each heading no proper steps can be taken to avoid trouble in the future. Conversely, when results have been unusually good the same information is wanted in order that these good results may be repeated.

The whole tendency on the part of the consumer appears to be to demand an improved quality, while considerations of finance demand that there shall be no reduction of output. The only way to meet these two conflicting conditions is by refinement of method.

Pyrometers in the Foundry.

The problem of applying pyrometers to the foundry is in many cases a difficult one. Plant has been erected and methods adopted without reference to a provision for pyrometers. The design of a charge handling plant that did not provide for weighing the materials would be ridiculed, yet the provision of apparatus for measuring the temperature which is of comparable importance has been entirely neglected. The particular form of the difficulties to be faced becomes therefore one of details. That the pyrometers which will be described later are intrinsically accurate enough there can be no possible doubt. They are successfully applied to operations calling for much greater refinement than is at present contemplated in foundry work. This being so, a description of the form and principle of the pyrometers will be the best method, explaining their detail application. But it must be here stated that in order to make a success of it, the application must be the result of collaboration between the foundryman and the pyrometer maker. Usually the cost of the pyrometer outfit, even if elaborate, will be negligible compared with the saving, supposing only one per cent of the wastage is saved, therefore the proposition is one well worth examination.

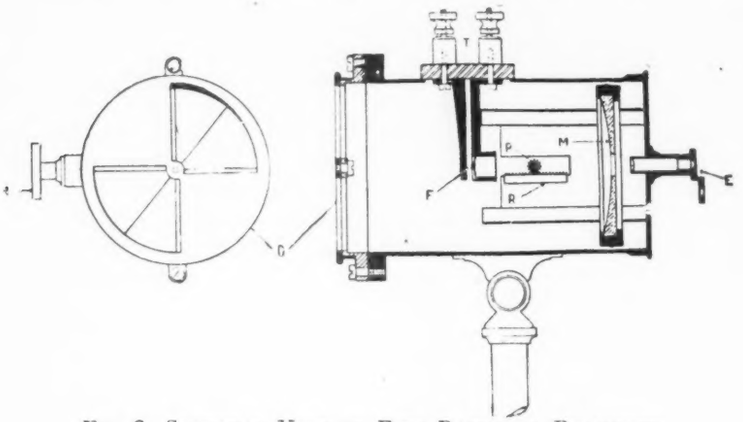


FIG. 2—SECTIONAL VIEW OF FERY RADIATION PYROMETER

FIG. 3—THE PROPER FOCUSING OF THE IMAGE IS SHOWN ON THE RIGHT

Two Types Considered.

The two main types of instruments to be described are first, the radiation, and second, the thermo-electric type. In the first class come optical pyrometers generally, and also the Fery radiation pyrometer. We may at once dismiss all the strictly optical pyrometers as unsuitable for foundry practice. They involve flame standards or batteries, or other complications which render their use more suited for the laboratory. They further require the operator to be skilled, careful and consistent if they are to give results at all satisfactory. And it is here of importance to note that the use of one type of pyrometer in the foundry and another type in the laboratory is to be avoided, because it is often difficult to get results that are strictly comparable when the read-

FIG. 4—PORTABLE PYROMETER IN USE

ings are made with pyrometers of widely different types.

The Fery radiation pyrometer combines the simplicity of the thermo-electric type with the advantage of working at a distance. The measurement is made by measuring the focussed radiant heat from the hot body. In Fig. 2 the pyrometer is shown in section on the right. The concave mirror M, gilded on the face, receives the heat rays coming from the hot body and focusses them on to one junction of a very small thermocouple at F. The effect of the focussed radiation is to heat the thermojunction and to cause an electric current to flow as soon as a circuit is provided for it. This circuit in practice consists of the binding posts T, a flexible cable and an accurately calibrated millivoltmeter. The calibration of the millivoltmeter is such that the pointer in moving over the scale indicates directly the temperature of the hot body at which the pyrometer is pointed.

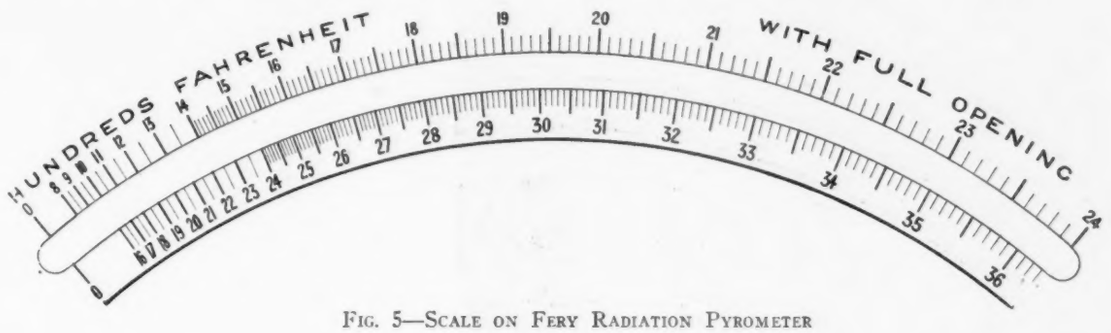


FIG. 5—SCALE ON FERY RADIATION PYROMETER

The current that flows in the circuit will be proportional to the excess of temperature of the thermojunction above the rest of the circuit in the pyrometer. The reading will therefore be independent of the general temperature of the air surrounding the pyrometer and will depend only on the temperature of the hot body under examination. An ingenious construction enables the user to see at once that he has the instrument properly pointed and also renders its action, within wide limits, quite independent of distance. Fixed in front of the thermojunction at F, are two small semi-circular mirrors with a central hole bored on their line of junction. This hole, seen as a black spot in Fig. 3, allows the radiant heat to be focussed on to the thermojunction. The two semi-circular mirrors are set at a slight angle to each other so that they split the image of the hot body into two portions, when viewed through the eyepiece E, Fig. 2. These two portions join up correctly when the instrument is properly focussed; thus in Fig. 3, the view on the right is properly focussed. The focusing is done by turning the milled head H, in Fig. 2, until the image, as seen through the eyepiece joins up correctly and looks as it does when seen with the naked eye. The only limitation to working distance is given by the fact that the focussed image must overlap the black spot all around. The overlapping may be as large or as small as other circumstances render convenient, thus once within the required limit, the action is independent of distance.

To see why this is so it is only necessary to remember that as the pyrometer approaches the hot body and receives more radiant heat, the size of the focussed image is proportionately increased so that once the minimum overlap is secured the only effect of going nearer will be to increase the overlap. We see therefore, that looking in the eyepiece the observer is at once informed as to the pointing in the right direction, the focusing and the working distance. Once set up and focussed, an operation taking not more than two minutes, the instrument becomes continuous and automatic in its action.

Portable Pyrometer.

Fig. 4 shows the portable outfit in actual use and it will be seen that the man reading the indicator need pay no attention to anything beyond the movement of the pointer over the scale. The advantages of applying such an instrument to foundry work become at once apparent. Pyrometers requiring direct insertion into the molten metal are either destroyed by the action of the metal or their protection must be so thick that it renders them hopelessly sluggish and therefore useless. Wherever an unobstructed view can be had of the hot body, this Fery pyrometer can be used; for instance, in crucible melting furnaces, tilting

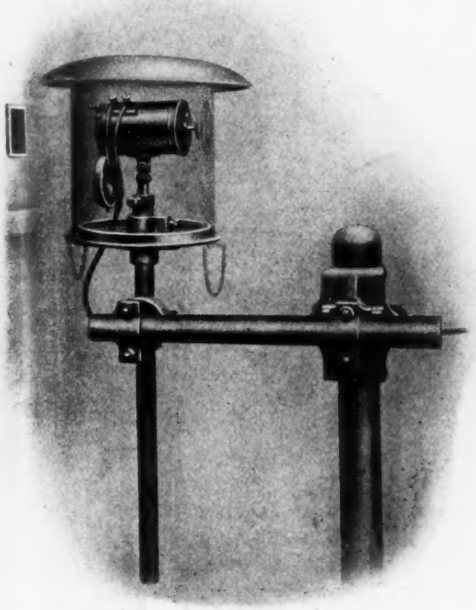


FIG. 6—FERY PYROMETER FIXED IN A STATIONARY POSITION, PROVIDED WITH A COVER

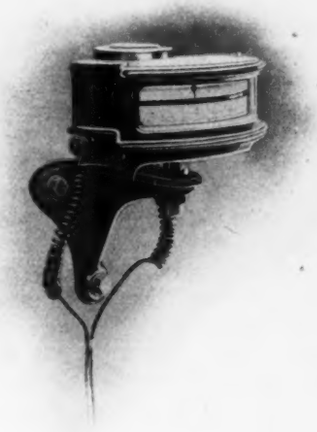


FIG. 7—WALL TYPE INDICATOR

furnaces, the spout of a furnace or cupola, the ladles and annealing furnaces. The range of the instrument is extended by the use of an adjustable diaphragm shown at D, Fig. 2. When this is swung over the mouth of the tube the sensibility is reduced with the result that a second scale is obtained of higher range. In Fig. 5 a typical scale is shown, the lower scale being with the diaphragm on. Thus, in one instrument, readings can be made from 800 to 3,600 degrees, Fahr. Of course, it will be evident that by a different setting of the diaphragm the range may be carried as high as desired.

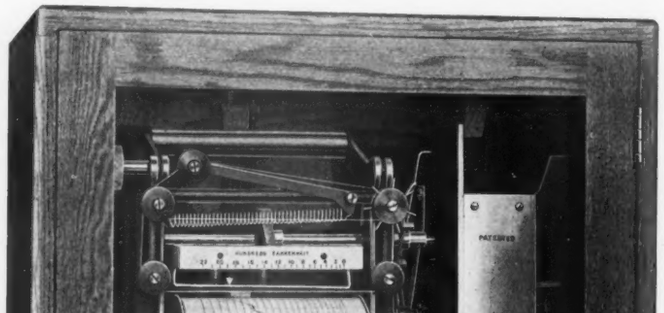


FIG. 8—THE RECORDER

Radiation.

Of course it is not to be supposed that the application of a method so novel to an industry so old has been made without diffculty. At the outset the laws of radiation were not well understood and considerable misunderstanding arose on account of this. Bodies inside nearly closed and approximately, uniformly heated spaces all act alike independent of the nature of their surface. Out in the open, however, this is not so. For instance, a stream of molten iron taken just where it emerges from the spout, and is therefore free from oxide, has a highly reflecting surface and gives out only a fraction of the energy that would come from it when covered with an oxide skin. The result in practice is simply that we have to add a constant percentage to the reading when the Fery pyrometer is sighted at such a clean stream. Since for these constant conditions the correction is a constant percentage the whole thing may, in practice, be ignored for the uncorrected reading serves equally well to fix the temperature treatment of the metal. The corrections for various standard materials and conditions have been ascertained experimentally under actual service conditions.

Methods of Application.

There are alternative methods of applying the radiation pyrometer. It may be used in a portable form as a general exploring instrument and is put up in a neat carrying case. On the other hand it may be permanently fixed in position as shown in Fig. 6, where it is covered by a stout cover. The cover of course has the back to verify the accurate pointing after the hood is on. With this instrument the portable indicator may be replaced by a wall type instrument such as shown in Fig. 7. Here the advantage is gained that the scale is easily visible at a distance and can be swiveled to face in any desired direction. The indicating instrument may be replaced by a recorder. The type used has been specially developed for this purpose and gives continuously visible records in ink. Fig. 1 is an example on a reduced scale. The recorder is shown in its case in Fig. 8. The actual record is produced by a clock depressing the pointer onto an inked thread so that a dot is left upon the paper representing the instantaneous deflection of the pointer. Between the depressions of the pointer it is free to take up its true deflection, uninfluenced by pen friction. It will be seen that the record produced has rectangular co-ordinates, that is to say, the division lines are all straight.

On the whole, the radiation pyrometer bids fair to work a great change in foundry practice and the prediction is made with confidence that its use will soon become standard practice.

Thermo-Electric Types.

Turning to the thermo-electric type we come to instruments whose particular field is the measurement of lower temperatures. They consist essentially of a thermocouple, or fire-end, a connecting cable and an indicator or recorder. A portable outfit is shown complete in Fig. 9. The attachment of the cable to the head of the thermocouple is made by a quick action, non-reversible plug, so that the indicator may be carried from point to point and quickly attached to a series of thermocouples set at various points. In another type the various thermocouples are connected by cables to a central position where a switchboard enables a wall type indicator to be connected to each point in turn. Fig. 10 shows the thermocouple and attachment plug in detail, while Fig. 11 illustrates the indicator and switchboard. The thermocouple relies for its action

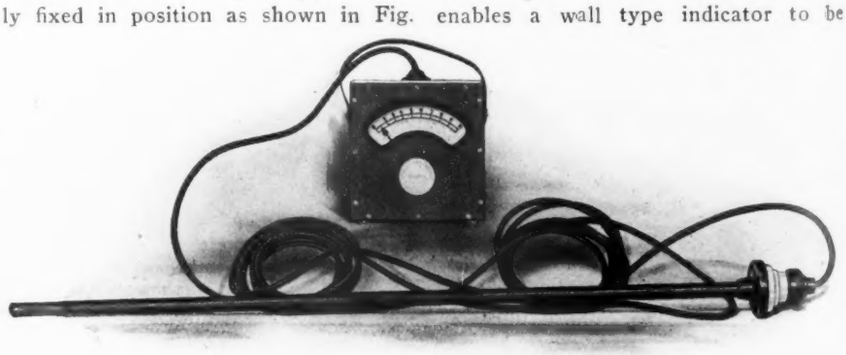


FIG. 9—COMPLETE, PORTABLE, THERMO-ELECTRIC OUTFIT

upon the electromotive force set up at the junction of two different metals when the junction is heated. The amount of the force and the consequent current through the indicator is proportional to the temperature of the junction. The choice of metals from which a thermocouple may be made would appear at first sight to be a very wide one. But in reality this is not so. The first limitation is the melting points of the two metals. In commercial practice this limit is never attained because the accuracy of a thermocouple is lost before the melting point is reached. There are secondary effects that cause a deterioration of the metals at temperatures much below their melting points. For work of high accuracy, the couple selected by Le Chatelier in his invaluable work is the best. This is the couple made of one wire of platinum against another of platinum alloyed with 10 per cent of rhodium. Here we are met by two fundamental necessities, the first is that the indicator must be of very high sensibility and at the same time of very high electrical resistance, two opposing conditions, and second, that the wires must be carefully protected from all metal vapors. The first point makes the instrument expensive and the second limits its use. However, after very many years of experience there is no doubt, that the platinum-rhodium thermocouple is capable of high accuracy when properly used. For work requiring great robustness and where the

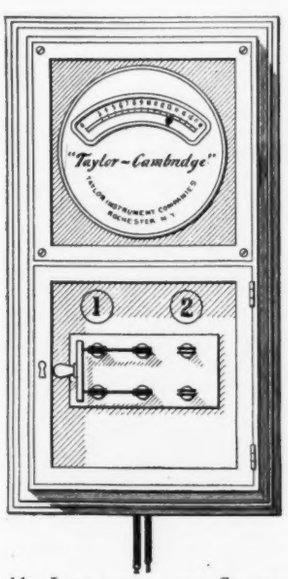


FIG. 11—INDICATOR AND SWITCHBOARD

temperatures are not extreme, thermocouples can be made of cheaper alloys not calling for such difficult conditions for their use. It is essential for the user of these cheaper alloys to be sure that his instruments remain in accurate calibration. The danger to be feared in this case is, that the continued application of the heat alone will set up a deterioration and in certain types, errors as high as 20 per cent may arise before the entire failure warns the user that replacement is necessary. What is to be sought, therefore, in this field is a thermocouple whose accuracy will remain within a few per cent to the end of its life. Such instruments are now to be had if the temptation to push their temperature limits too high is resisted.

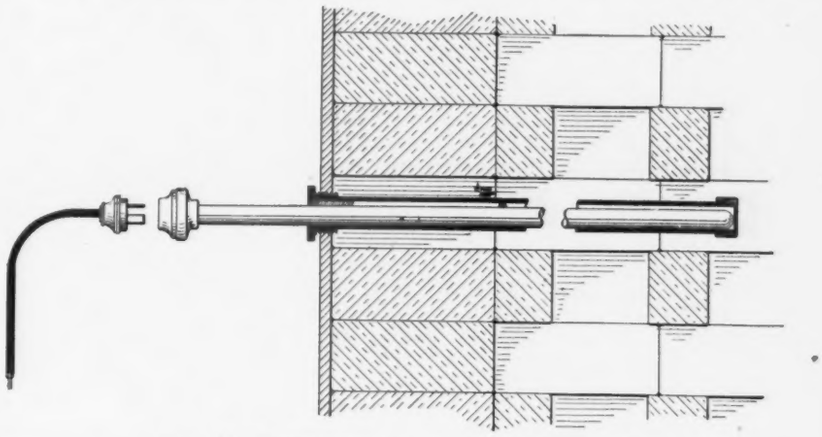


FIG. 10—THERMOCOUPLE AND ATTACHMENT PLUG

Application of Thermo-Electric Types.

The application of these thermo-electric types is most useful in the case of the low melting, non-ferrous alloys and for core ovens and annealing furnaces. Here they give most valuable service and a wide installation can be made at low cost.

Altogether the combination of the Fery pyrometer with suitable thermo-electric instruments provides a scheme capable of measuring and recording the two essential factors of temperature and time and they must therefore lead to reduction in losses and improvement in quality of the castings produced.

MONEL METAL.

Monel metal consists primarily of nickel and copper in the proportion of three parts of nickel to one part of copper, this being the natural proportion in which these metals exist in the largest deposits of nickel ore in the Sudbury district of Canada. Throughout its entire manufacture this alloy acts as a single metal, and while the proof is still incomplete, evidence seems to show that in these proportions nickel and copper have a remarkable affinity for each other.

Like steel, this alloy absorbs carbon, and, like steel, its physical properties are profoundly influenced not only by the percentages of carbon, silicon, etc., but by the heat treatment it receives. A standard analysis of Monel metal is as follows: Nickel, 68 to 72 per cent; iron, 0.5 to 1.5 per cent; sulphur, 0.014 per cent; carbon, 0.073 to 0.15 per cent; copper to balance.

This alloy is silver-white and takes a brilliant finish, which it retains indefinitely. On prolonged exposure the surface assumes a grayish cast, which may be easily removed with a polishing cloth. In the rolled sheets the surface assumes, on heating, a coating of oxide which has great resistance to acids. Samples of the rolled metal showed no loss in 56 days' test in pumping a 40 degree sulphuric acid. A special pickle has to be used to remove the oxide coat for articles destined to be polished, but for purposes where resistance to acid is required, the oxide coating is allowed to remain.

Monel metal melts at 1,350 degrees Cent. It can be rolled perfectly from 900 degrees to 1,200 degrees Cent., and its annealing temperature is above 875 degrees Cent. It can be finished hard or soft, like sheet copper. Its specific gravity, as cast, is from 8.86 to 8.87, and when rolled from 8.94 to 8.95.—*Electrochemical and Metallurgical Industry.*

Hugo Vits, Manitowoc, Wis., has been appointed purchasing agent of the Aluminum Goods Mfg. Co., recently organized in New York City by a consolidation of three concerns operating aluminum foundries. For the present, Mr. Vits will have his headquarters in Manitowoc, but later may be transferred to New York or Chicago, the principal offices of this concern being located in New York.

Founders' Week, Cincinnati, May 17-22

Program of Events, including the Convention Proceedings, Exhibition and Entertainment Features

ALL indications point to a record-breaking attendance of foundrymen in Cincinnati during "Founders' Week"—May 17 to 22. The attractions will include the annual conventions of the American Foundrymen's Association, the American Brass Founders' Association, and the Associated Foundry Foreman, as well as the exhibit of foundry supplies and equipment conducted under the auspices of the Foundry and Manufacturers' Supply Association. Other powerful foundry trade organizations, not allied with the American Foundrymen's Association, will hold their regular meetings in Cincinnati at this time to permit their members to attend the professional sessions and to inspect the display of foundry appliances.

For several months, local committees have been making preparations for the reception and entertainment of the visitors, which will fully measure up to the high standard of hospitality for which Cincinnati is noted. Several inspection tours to local plants are also being arranged and these should prove unusually interesting, inasmuch as Cincinnati is the center of the machine tool industry of the world.

Where the Meetings will be Held.

The business and the professional sessions, as well as the exposition of foundry appliances, will be held in Music Hall, where the registration booth will be located, and the headquarters of the American Foundrymen's Association and the American Brass Founders' Association will be established at the Hotel Sinton, while the Associated Foundry Foremen will be at the Grand Hotel.

Practically all of the available space devoted to the exhibits in Music Hall, as well as the temporary building, especially erected for this occasion, has already been reserved, and the large number of operating exhibits will convert this hall into a model foundry. All of the appliances that have made possible the notable progress in molding machine practice, recorded during the past year, will be displayed. Molds, varying in weight from a few pounds to 10,000 pounds, will be made. By far the most complete line of brass furnaces ever shown will be in operation in the temporary building, and many special and interesting demonstrations will be made each day. The display of foundry supplies will be unusually complete and will encompass every requirement of the modern foundry, whether producing iron, steel, brass or malleable castings. The machine tool exhibit will also prove a novel feature, and the mechanical wood-worker should prove of interest to those engaged in pattern shop work.

The interest manifested in this exhibit by manufacturers generally is reflected in the following list of new members enrolled in April, many of whom will make exhibits: Sterling Wheelbarrow Co., Milwaukee; Walter Macleod & Co., Cincinnati; Philadelphia Chaplet & Mfg. Co., Philadelphia; S. Birkenstein & Sons, Chicago; Brown Specialty-Machinery Co., Chicago; Pickands, Brown & Co., Chicago; Parker Bros. Co., Ltd., Detroit; Burroughs Adding Machine Co., Detroit; Newport Sand Bank Co., Newport, Ky.; Ed. E. Squires Sand Co., St. Louis; Wm. Sellers & Co., Philadelphia; R. F. Goyne, New York City; *Metal Industry,* New York City; Manufacturers' Equipment Co., Chicago; Sand Mixing Machine Co., New York City, and the Hanna Engineering Works, Chicago.

CONDENSED CONVENTION PROGRAM

Monday, May 17, 8 p. m.

Foundry foremen's smoker, Grand Hotel.

Tuesday, May 18, 2 p. m.

Opening session of the American Foundrymen's Association and the American Brass Founders' Association in the convention hall.

Tuesday Evening.

Reception to visiting foundrymen and their ladies at the Hotel Sinton.

Wednesday, May 19, 10 a. m.

Joint professional session of the American Foundrymen's Association and the American Brass Founders' Association.

Wednesday, 2 p. m.

Joint professional session of the American Foundrymen's Association and the American Brass Founders' Association.

Thursday, May 20, 10 a. m.

Joint professional session of the American Foundrymen's Association and the American Brass Founders' Association. The time of the final business meetings of these two organizations to be announced.

Thursday Afternoon and Evening.

Boat ride and barbecue at a Kentucky pleasure resort.

The exhibition in Music Hall and the temporary building will be open throughout the day and evening the entire week.

The annual meeting of the Foundry & Manufacturers' Supply Association, as well as the business meeting of the Associated Foundry Foremen will be held during the latter part of the week.

Admission Fee.

A nominal charge of 25 cents for a single admission to the exhibition hall only, will be made, and season tickets can be secured for $1.00, covering attendance the entire week. These can be purchased when registering. Admission to the professional sessions is free, however, and all visiting foundrymen are invited to attend. This charge is made to eliminate all curious and disinterested parties, leaving more room for those who attend for business purposes.

Professional Sessions.

The professional sessions of the American Foundrymen's Association and the American Brass Founders' Association will be held jointly in Music Hall so that the members of the one organization, interested in the professional papers of the other, may not be deprived of the information thus obtainable. The provisional program outlined by the secretaries of these two bodies is replete with papers on timely topics of the utmost interest to every foundryman engaged in iron, steel or brass work, and many problems have also been propounded in the "question box" that should develop interesting discussions. The report of the committee on "Standard Specifications for Foundry Pig Iron" will be presented

at the opening session. This is the result of many conferences between producers and consumers and will be presented for final adoption. There is also a movement on foot to appoint a committee to compile standard methods of analysis for brass and kindred alloys, and the American Brass Founders' Association has already secured the co-operation of the United States Bureau of Standards and the American Chemical Society to further this work. This subject will be discussed at one of the professional sessions, and definite action will undoubtedly be taken. The meeting of the Associated Foundry Foremen will be opened with a smoker to be held at the Grand Hotel, Monday evening, May 17. Tickets for this affair can be had for $1.00 and all foremen, regardless of membership in the Associated Foundry Foremen, are invited to attend. Announcement of nominating and auditing committees, as well as the time of future meetings will be made, and an opportunity will be afforded the members to do active campaign work in behalf of the organization. The Chicago Associated Foundry Foremen have chartered a special Pullman train which will leave the Union depot, Madison and Canal streets, Chicago, at midnight, Sunday, May 16, arriving in Cincinnati the following morning. In addition to the Chicago delegates, the party will include members of the Milwaukee and Tri-City Foremen's Associations, as well as many foundrymen located in the west. Reservations can be made by addressing E. W. Smith, chairman of the committee on transportation, 434 Franklin avenue, Chicago.

Provisional Convention Program

Tuesday, May 18

Opening Session, 2 p. m.

Addresses of welcome and responses.

Address by L. L. Anthes, president of the American Foundrymen's Association.

Address by Chas. J. Caley, president of the American Brass Founders' Association.

Reports of the secretaries and treasurers of the American Brass Founders' Association and the American Foundrymen's Association will be presented, as well as reports of standing committees on "Standard Specifications for Foundry Pig Iron" and the "Prevention of Accidents in Foundries."

Tuesday Evening

A reception will be tendered the visiting foundrymen and their ladies by the Cincinnati entertainment committee at the Hotel Sinton. This will be known as "Get Together Night."

Wednesday, May 19

Professional Session, 10 a. m.

Papers of the American Brass Founders' Association.

"The Manufacture of Brass Ingots, Their Use and Advantages," W. M. Corse.

"The Use of Waste Heat," F. W. Reidenbach.

"The Patent Situation in the United States Respecting Alloys," C. H. Clamer.

Papers of the American Foundrymen's Association.

"The Cost of Steel Melting in Foundries," Dr. Bradley Stoughton. This paper will be illustrated with lantern slides.

"The Side Blow Converter for Steel Castings and Its Operation," J. S. Whitehouse.

"Open-Hearth Methods for Steel Castings," W. M. Carr.

"Notes on Air Furnace Construction for Malleable Castings," W. H. Kane.

"The Use of Pulverized Coal for Foundry Purposes," R. K. Meade.

"Molding Machines versus Hand Molding," Geo. Muntz.

"Pattern Shop Equipment," A. N. Spencer. Illustrated with lantern slides.

Wednesday Afternoon

Professional Session, 2 p. m.

Papers of the American Foundrymen's Association.

"The Heart of the Foundry as seen by the Foundry Engineer," D. S. Hawkins.

"Cores and Core Making," F. K. Cheney.

"Continuous Melting in the Foundry of the Westinghouse Air Brake Co.," S. D. Sleeth.

"Continuous Melting," R. H. Probert.

"The Permanent Mold," E. A. Custer. Illustrated with moving pictures showing the production of castings in permanent molds.

"The Practical Value of Chemical Standards for Iron Castings," Dr. J. J. Porter.

"Pyrometry in the Annealing Room," S. H. Stupakoff.

Papers of the American Brass Founders' Association.

"General Principles of Operation of Industrial Pyrometers," C. H. Wilson.

"Notes on Brass Melting," Chas. T. Bragg.

"Melting of Brass Turnings in the Oil Furnace," E. H. McVeen.

Thursday, May 20

Professional Session, 10 a. m.

Papers of the American Brass Founders' Association.

"Electrolytic Assay of Copper," Geo. L. Heath.

"A System of Distributing Waste Losses in Raw Materials to the Cost of the Finished Product," L. W. Olsen.

"The Tensile Strength of Zinc-Aluminum Alloys," W. D. Bancroft.

Papers of the American Foundrymen's Association.

"A Comprehensive Foundry Production Tally," C. E. Knoeppel.

"Foundry Costs," B. C. Franklin.

"Specifications for Foundry Facings," H. F. Frohman.

"Foundry Transportation Methods," David Gaehr.

"Modern Cupola Practice," J. C. Knoeppel.

"Use of Steel Scrap in the Cupola," C. R. McGahey.

The business sessions of the American Foundrymen's Association and the American Brass Founders' Association, for the election of officers, will be held in separate halls at the conclusion of the morning session.

Thursday Afternoon and Evening

Boat ride on the Ohio river and barbecue at a noted Kentucky pleasure resort.

(In addition to the papers included in this provisional program, a number of others have been promised and many interesting questions have been submitted which will be presented for discussion during the professional sessions.)

Exhibits.

ARCADE MFG. CO., Freeport, Ill. Spaces Nos. 30 to 35.—The molding machines exhibited in this booth will be operated and will include the latest types of Modern machines provided with pneumatic vibrators and automatic tripping attachments, as well as one 26-inch Norcross jolting machine and the Buck's roll-up device. Arrangements have been made for the production of very large molds, as the Norcross machine is built to handle flasks weighing up to 15,000 pounds. An extensive display of castings produced on the molding machines manufactured by this concern will also be made.

BAIRD & WEST, Detroit. Space No. 85.—By-product coke for foundry use.

BARNETT, OSCAR, FOUNDRY CO., Newark, N. J. Space No. 117.—Full line of iron flasks for iron, steel and brass foundry use.

BARTLEY, JONATHAN, CRUCIBLE CO., Trenton, N. J. Space No. 76.—A complete line of regular and special crucibles, together with stoppers, nozzles, etc., as well as complete graphite equipment for foundry use.

BERKSHIRE MFG. CO., Cleveland. Spaces Nos. 8 and 9.—The molding machines in this exhibit will be shown in operation, and will include the Berkshire automatic machine; hand squeezer and pattern-drawing molding machine, as well as rotary sand riddles, aluminum and iron snap flasks.

BIRKENSTEIN, S., & SONS, Chicago. Space No. 21.—Phosphor-bronze, brass ingots and other metals for brass foundries.

BROWN SPECIALTY-MACHINERY CO., Chicago. Space No. 101.—The core room equipment exhibited will be operated, and will include one Hammer core machine, core tapering machine, as well as cabinets for the same.

BUCH'S, A., SONS CO., Elizabethtown, Pa. Spaces Nos. 60 to 67.—An improved gravity molding machine will be shown in operation producing molds from a miscellaneous lot of

patterns. A combined, portable jarring and squeezer molding machine will also be exhibited, and demonstrations will be made from 9 to 10 and 11 to 12 a. m., and 2 to 3 and 4 to 5 p. m.

BURROUGHS ADDING MACHINE CO., Detroit. Space No. 84.—Special adding machines adapted for foundry cost keeping will be shown. A paper will also be read before the American Foundrymen's Association describing the application of this machine to foundry cost work.

CALUMET ENGINEERING CO., Harvey, Ill. Space No. 20.—Calumet cupola, air hoists, ladles and other foundry equipment.

CANADIAN MACHINERY, Toronto. Space No. 123.

CARBORUNDUM CO., Niagara Falls, N. Y. Space No. 23.—Carborundum wheels for foundry use will be attractively displayed, together with samples of all grits manufactured by this concern. The representatives in charge of this exhibit will include George R. Rayner, W. W. Sanderson, H. W. Eaton and R. B. Fuller.

CASTINGS, Cleveland. Space No. 113.

CLEVELAND WIRE SPRING CO., Cleveland. Space No. 41.—Shop furniture, including steel barrels and boxes, trucks and a full line of steel factory equipment.

CRIVEL, GEORGE F., & CO., Buffalo. Space No. 96.—This booth will be fitted up for the comfort of the visiting delegates.

CURTIS & CO. MFG. CO., St. Louis. Spaces Nos. 30 to 35.—All the machinery in this exhibit will be shown in operation and will include an air compressor, sand blast, air hoists especially designed for foundry work, as well as photographs of special foundry cranes, trolley systems and pneumatic elevators. In addition, a new overhead molding machine will be operated in conjunction with the Norcross machine that will be displayed by the Arcade Mfg. Co.

DETROIT FOUNDRY SUPPLY CO., Detroit. Space No. 95.—This space will be fitted up as a rest room for the visitors at the convention. A line of foundry supplies will also be shown.

DETROIT TESTING LABORATORY, Detroit. Space No. 116.—This booth will be fitted up with easy chairs and other conveniences for the visitors at this convention.

DIAMOND CLAMP & FLASK CO., Richmond, Ind. Space No. 104.—Automatic core machines will be shown in operation making all kinds of special cores such as are used for fittings, including valves, tees, etc. A plunger type core machine will be displayed making stock and irregular cores. The display will also include a core cutter, a core cutting-off machine for cutting standard cores, a core coning machine, and in addition snap flasks, slip jackets, asbestos core plates, adjustable flask clamps, patternmakers' bench trimmers, lathe chucks, etc., will be shown.

DIXON, JOSEPH, CRUCIBLE CO., Jersey City, N. J. Space No. 75.—Crucibles for melting steel and the non-ferrous metals. Many pots will also be shown that have been used for a large number of heats.

DOGGETT, STANLEY, New York City. Space No. 43.—Complete line of foundry facings and other foundry supplies.

FALLS RIVET & MACHINE CO., Cuyahoga Falls, O. Spaces Nos. 119 to 122.—This booth will be fitted up as a model core room and the following equipment will be shown in operation: Wadsworth combined sand mixer, compounder and riddle; No. 1, No. 2 and No. 3 improved core-making machines, portable core ovens, core cutting-off and coning machine, gagger mold with sample gaggers, samples of various sizes and shapes of cores, and cabinets containing a complete line of Wadsworth standard core prints.

FOUNDRY SPECIALTY CO., Cincinnati. Space No. 73.—"Fluxine," a flux for brass foundry use, as well as "Partine," a parting compound, will be exhibited.

THE FOUNDRY, Cleveland. Spaces Nos. 78 and 80.

GOLDSCHMIDT THERMIT CO., New York City. Temporary building.—Demonstrations will be made of thermit for foundry use.

GOYNE, R. F., New York City. Temporary building.—Melting furnaces for melting the softer metals will be shown in operation.

HAWLEY DOWN DRAFT FURNACE CO., Chicago. Temporary building.—Furnaces for melting the softer metals as well as steel, will be shown in operation.

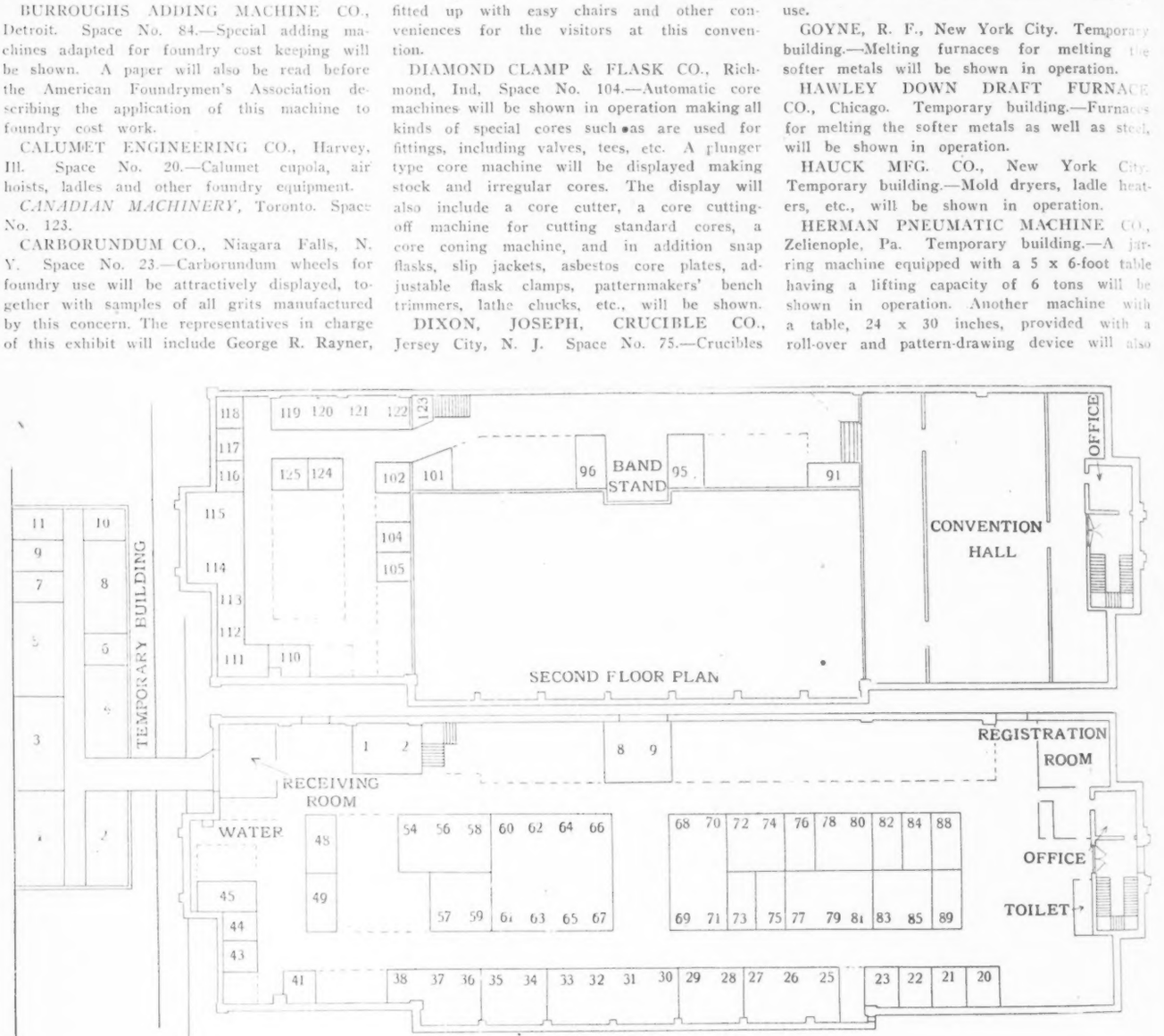
HAUCK MFG. CO., New York City. Temporary building.—Mold dryers, ladle heaters, etc., will be shown in operation.

HERMAN PNEUMATIC MACHINE CO., Zelienople, Pa. Temporary building.—A jarring machine equipped with a 5 x 6-foot table having a lifting capacity of 6 tons will be shown in operation. Another machine with a table, 24 x 30 inches, provided with a roll-over and pattern-drawing device will also be shown, as well as a wheelbarrow ladle carrier, so constructed that one man can easily handle 200 pounds of molten metal. In addition, a roll-over device for handling large molds will be installed, as well as a combination machine which embodies the jarring and pressing principle, that can be arranged for match plate and stripping plate work, will be exhibited.

HICKMAN, WILLIAMS & CO., Chicago. Space No. 82.—A complete line of pig iron samples.

HILL & GRIFFITH CO., Cincinnati. Spaces Nos. 73 to 74.—Full line of perforated chaplets, molders' flat back shovels, portable core oven, sand sifting machines, iron filling cements and specialties, crucibles, foundry brushes, bellows, riddles and other foundry supplies.

HOLLAND LINSEED OIL CO., Chicago. Space No. 105.—Holland linseed core oil will be exhibited, and cores will be made and baked, using this oil in the core mixtures in



MUSIC HALL, CINCINNATI, FIRST AND SECOND FLOOR PLANS, SHOWING LOCATIONS OF EXHIBITS

the proportions of one of oil to 60 of sand.

KILLING'S, E., MOLDING MACHINE WORKS, Davenport, Ia. Spaces Nos. 57 to 59.—All the molding machines in this exhibit will be operated, including three different styles of roll-over machines and one roll-out machine, and a complete line of steel flasks will also be shown.

KROESCHELL BROS. CO., Chicago. Temporary building.—The Kroeschell-Schwartz, gyrating flame, stationary crucible furnace, equipped with an oil pumping and blower system, adapted for melting the softer metals, will be shown in operation, using both oil and gas for fuel. A new type of tilting furnace will also be displayed, as well as a drying stove. This concern will be represented by W. L. Kroeschell and Mr. Schwartz.

MACLEOD, WALTER & CO., Cincinnati. Space No. 49.—Heaters, oil rivet forges, brazing furnaces, blacking swabs, Buckeye lights, sand blasting machines, whitewash sprayers, mold dryers, lead and melting furnaces and a crucible melting furnace.

MANUFACTURERS EQUIPMENT CO., Chicago. Space No. 100.—Machine tools and appliances for finishing brass goods.

McCORMICK, J. S., CO., Pittsburg. Spaces Nos. 28 and 29.—A complete line of foundry supplies will be exhibited, and among the equipment will be displayed the McCormick continuous sand mixer and a magnetic separator.

MILLERS' PRODUCTS CO., Chicago. Space No. 103.—"Black Diamond" core compound will be shown, as well as various grades of foundry flour. The booth will be provided with desks and chairs for visiting foundrymen, who will also be afforded an opportunity of taking care of their correspondence in this space.

MONARCH ENGINEERING & MFG. CO., Baltimore. Temporary Building.—Complete line of melting and refining furnaces, including the Steele-Harvey, crucible tilting furnace, the Monarch stationary furnaces, core ovens, portable heaters, blowers, etc. The brass furnaces will be shown in operation.

MUMFORD, E. H., CO., Philadelphia. Spaces Nos. 30 to 35, also temporary building.—Jointly with the Curtis & Co. Mfg. Co., this concern will exhibit the new Curtis-Mumford, overhead, power roll-over and pattern-draft molder. This will be operated over a large jolt ramming machine to be installed by the Arcade Mfg. Co.

NEWPORT SAND BANK CO., Newport, Ky. Space No. 102.—Samples of 16 varieties of molding sand mined and shipped by this concern will be exhibited, together with various samples of iron and brass castings made in the same.

OBERMAYER, S., CO., Cincinnati. Spaces Nos. 77 to 79 and 81.—This concern will exhibit in connection with the Whiting Foundry Equipment Co., Harvey, Ill., and will show a complete line of foundry equipment, as well as foundry supplies.

OLIVER MACHINERY CO., Grand Rapids, Mich. Spaces Nos. 1 and 2.—The Waddin Universal Woodworker will be shown in operation, and any pattern or core box that visitors desire to have made will be produced by the operator. By the use of this machine, the time required for making patterns within its scope is reduced from 10 to 85 per cent. In addition, there are many patternmaking operations which can be easily performed upon this machine that would require an ordinary patternmaker several days or perhaps weeks. A full line of machinery and equipment for the pattern shop will also be shown.

OSBORN MFG. CO., Cleveland. Spaces Nos. 52, 54 and 56.—The Osborn rock-over molding machine will be shown in operation, and various patterns will be mounted to show the adaptibility of this machine. This exhibit will also include a full line of brushes, brush wheels and other foundry supplies made by this concern, as well as the Osborn "Sivquick" riddle.

PAXSON, J. W., CO., Philadelphia. Space No. 88.—Molding machines and supplies, including aluminum flasks, pattern plates and divided frames, knee pads, vibrators, hose clamps and couplings and molders' bench and tub vibrating attachments. Castings of various kinds will also be shown that have been cleaned by the sand blast, and drawings and photographs will be exhibited of various sand blast installations. The foundry supplies that will be displayed include steel, brass and galvanized sieves, wire and bristle brushes of all shapes and sizes, bellows, tongs, shanks, hand, crane and geared ladles, and photographs will be displayed of cupolas and large trucks. The other equipment will include magnetic separators, tripod sifting machines and a round, steel shell, brass furnace. This exhibit will be in charge of H. M. Bougher, Howard Evans, L. A. Crandall, I. F. Kramer and Geo. W. Moore.

PICKANDS, BROWN & CO., Chicago. Space No. 83.—Solvay coke and various brands of pig iron for foundry use will be attractively displayed.

PRIDMORE, HENRY E., Chicago. Spaces Nos. 25 to 27.—The molding machines displayed in this exhibit will be operated and will include two small, square stand machines fitted up for molding spur gears; one special stove plate rock-over machine fitted for the production of stove patterns, one special stove plate rock-over drop machine of a special type, which will be exhibited at this convention for the first time; one 16 x 14-inch rock-over drop machine, having a drop of 5 inches, fitted with a pulley pattern; one 29 x 24-inch rock-over drop machine having an 8-inch drop, fitted up for production of large pipe fittings and one power ramming, rock-over drop, molding machine.

ROBESON PROCESS CO., Au Sable Forks, N. Y. Spaces Nos. 68 to 71.—Glutrin, a liquid core binder made by this concern, will be exhibited.

ROCKWELL FURNACE CO., New York City. Temporary building.—This exhibit will include furnaces of various types which will be operated, as follows: Lift out type of crucible furnace which can be installed singly or in batteries either above the floor or in a pit; tilting crucible, Simplex and double chamber melting furnaces; soft metal, melting furnace and an annealing, hardening and tempering furnace, in which the temperature is under the absolute control of the operator, as well as compressed air and self-contained type of portable heaters for skin drying molds and for heating work where a device of this kind is useful.

SAND MIXING MACHINE CO., New York City. Space No. 45.—Sand mixing machines.

SELLERS, WILLIAM, & CO., INC., Philadelphia. Space No. 48.—Two centrifugal sand mixing machines, one belt-driven and the other motor-driven. The latter will be shown in operation.

SLY, W. W., MFG. C., Cleveland. Space No. 89.—Photographs showing the complete line of tumbling mills, dust arresters, cinder mills, etc., made by this concern will be displayed.

SMITH, J. D., FOUNDRY SUPPLY CO., Cleveland. Temporary building.—Three pit brass furnaces, sprue cutter, molding machines, water tumbling mill, wall crane and numerous photographs of equipment. A large, rolling drawer type, core oven will be shown in operation.

SQUIER, E. E., CO., St. Louis. Space No. 44.—Complete line of foundry sand covering requirements for the finest brass to the heaviest machinery castings. Core sands, including white silica, lake, bank and magnesia, sand blast sand and quartz. Sample castings made in these various grades of sand, as well as coal and coke will also be shown. The exhibit will be in charge of R. H. and E. E. Squier.

STANDARD SAND & MACHINE CO., Cleveland. Temporary building.—Sand mixing, conveying and elevating machinery. A complete line of this equipment will be shown in operation.

STERLING WHEELBARROW CO., Milwaukee. Space No. 124.—Complete line of steel flasks for foundry use.

TABOR MFG. CO., Philadelphia. Spaces Nos. 36 to 38.—The following molding machines will be shown in operation: One 10-inch squeezer, one 14 x 16-inch split pattern machine, one 30-inch hinged molding machine with a 12-inch power draft, and an 18-inch hinged machine with an 8-inch hand draft.

WESTINGHOUSE ELECTRIC & MFG. CO., Pittsburg.—A display of Cooper-Hewitt lights will be made over the exhibit of Henry E. Pridmore, Chicago, spaces Nos. 25 to 27.

WHITING FOUNDRY EQUIPMENT CO., Harvey, Ill. Spaces Nos. 77 to 81.—This exhibit will be made in connection with that of the S. Obermayer Co., Cincinnati, and will include tumbling mills, ladles, shanks and turntables. Photographs will also be shown of the latest types of foundry cranes and other equipment.

TRADE PUBLICATIONS.

PATTERN SHOP AND FOUNDRY SUPPLIES.—The Shanafelt Mfg. Co., Canton, O., has issued a handsomely illustrated catalog describing the complete lines of pattern shop and foundry supplies which it manufactures. Various applications of curved side leather fillet are shown, as well as wood fillet, fillet tools, malleable iron rapping plates, lifting screws, dowel pins and plates, malleable iron pinch dogs, corrugated fasteners, etc. This concern also manufactures a complete line of letters and figures intended for marking and numbering patterns, and valuable instructions are given for fastening white metal letters to patterns and sweating brass letters on iron patterns. This concern likewise manufactures an unusually complete line of chaplets, which are shown in various sizes and shapes. Other equipment and supplies described include snap flasks, steel cement, casting brushes, bellows, etc.

BLOWERS.—The American Blower Co., Detroit, has just issued a 24-page catalog, which is largely devoted to a description of "Sirocco" blowers. It contains an interesting comparison of the "Sirocco" turbine wheel with the former standard steel plate fan wheel, and illustrations are given of typical applications of this fan for the ventilation of buildings and mines, for producing mechanical draft, etc. A new capacity table of "Sirocco" fans is also included, as well as a partial list of American users. A number of pages are also devoted to other types of apparatus made by this concern, including steel plate fans, vertical enclosed sc.f-oiling engines, etc.

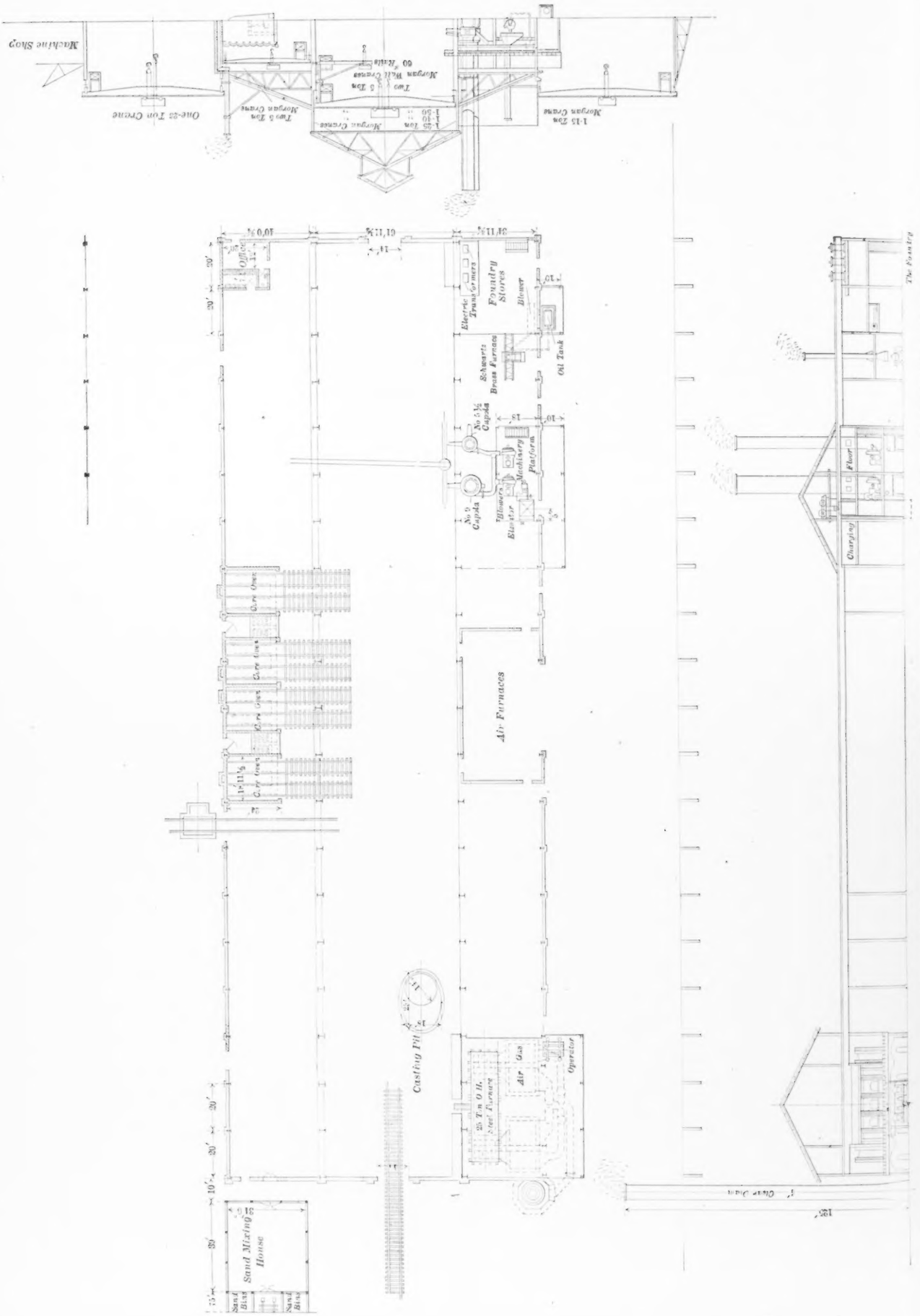


Fig. 1. General Plans, Side and End Elevations of the Indiana Steel Co.'s Foundry, Gary, Ind.

A MODERN STEEL WORKS' FOUNDRY

Description of the foundry department operated by the Indiana Steel Co. at Gary, equipped to produce castings in iron, steel or brass

A STEEL works' foundry is essentially a jobbing shop which must be prepared and equipped to produce, on short notice, castings in iron, brass or steel varying in weight from a few pounds to many tons. The sections frequently made in a shop of this kind not only include repair parts for the rolling mills and blast furnaces, but ingot molds, iron and steel rolls, as well as repairs for practically the entire machinery equipment. The repair shops provided for the new works of the Indiana Steel Co., Gary, Ind., are commensurate to the size of the plant, and among other equipment include a large foundry adequately equipped for the production of both light and heavy castings, pattern and carpenter shop and a commodious pattern storage.

The foundry is unique in that it contains under one roof brass, iron and steel departments, and provisions were made when the layout was adopted for two 15-ton air furnaces, which will shortly be built. The shop is, therefore, in position to meet every requirement of the blast furnace, steel producing and rolling departments, and with the exception of a limited number of patterns, which have been permitted to remain with the makers of equipment on which repairs are generally light, the pattern storage contains the models of the castings of the bulk of the machinery installed. With respect to the other repair shops, the foundry has been well located. It adjoins the machine shop on one side, a casting storage yard separating the two buildings, while the pattern and carpenter shop and the pattern storage are located on the opposite side of the main street, which extends practically through the entire plant.

General Arrangement of Foundry.

The general arrangement of the foundry is shown in Fig. 1. The building is of brick and steel construction 400 feet long, 137 feet wide, and is divided into three bays respectively, 35, 61 and 40 feet wide. In the side bay adjoining the raw material storage yard, the entire melting equipment is located including the brass melting furnace, cupolas, air and open-hearth furnaces. Heavy floor work is molded in the middle bay, while in the other side bay are located the core ovens, core making department and the light molding floor. A view of the center bay looking toward the core ovens is shown in Fig. 2. The building has a height of 74 feet to the

FIG. 2—GENERAL VIEW OF THE FOUNDRY, LOOKING TOWARD THE CORE OVENS

FIG. 1—GENERAL PLANS, SIDE AND END ELEVATIONS OF THE INDIANA STEEL CO.'S FOUNDRY, GARY, IND.

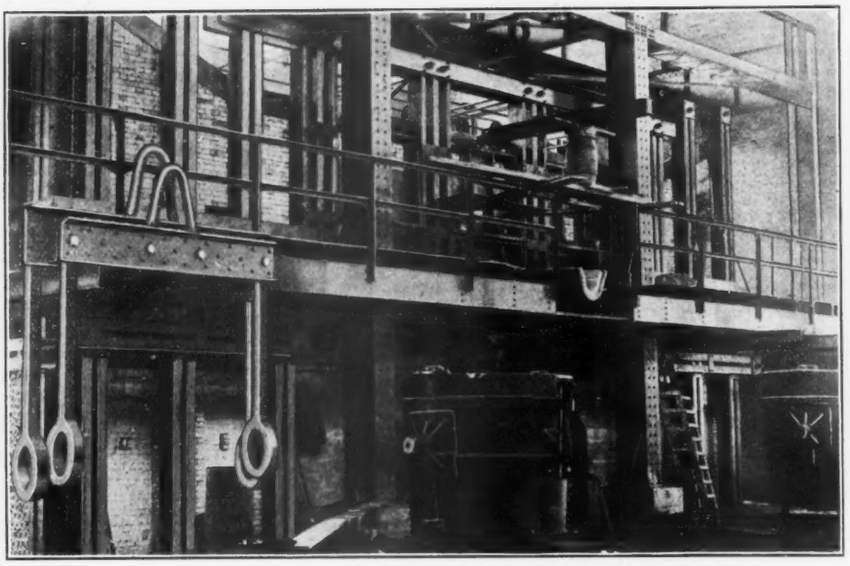


FIG. 3—THE 25-TON, ACID, OPEN-HEARTH FURNACE

peak, 48 feet 6 inches to the bottom chord of the roof trusses, and the base of the traveling crane rails is 33 feet 6 inches above the floor level, affording ample head room. The side bays are 22 feet high to the bottom of the chords of the roof trusses, and the traveling jib cranes have a clearance of about 15 feet. Two rows of windows, extending the entire length of the monitor, as well as a sky-light on both sides of the roof, afford good light from above, and two rows of windows extend almost the entire length of the sides, while three rows are located in the ends.

Crane Equipment.

Sufficient crane capacity has been provided in the middle bay for handling castings up to 200,000 pounds in weight. It includes electric traveling

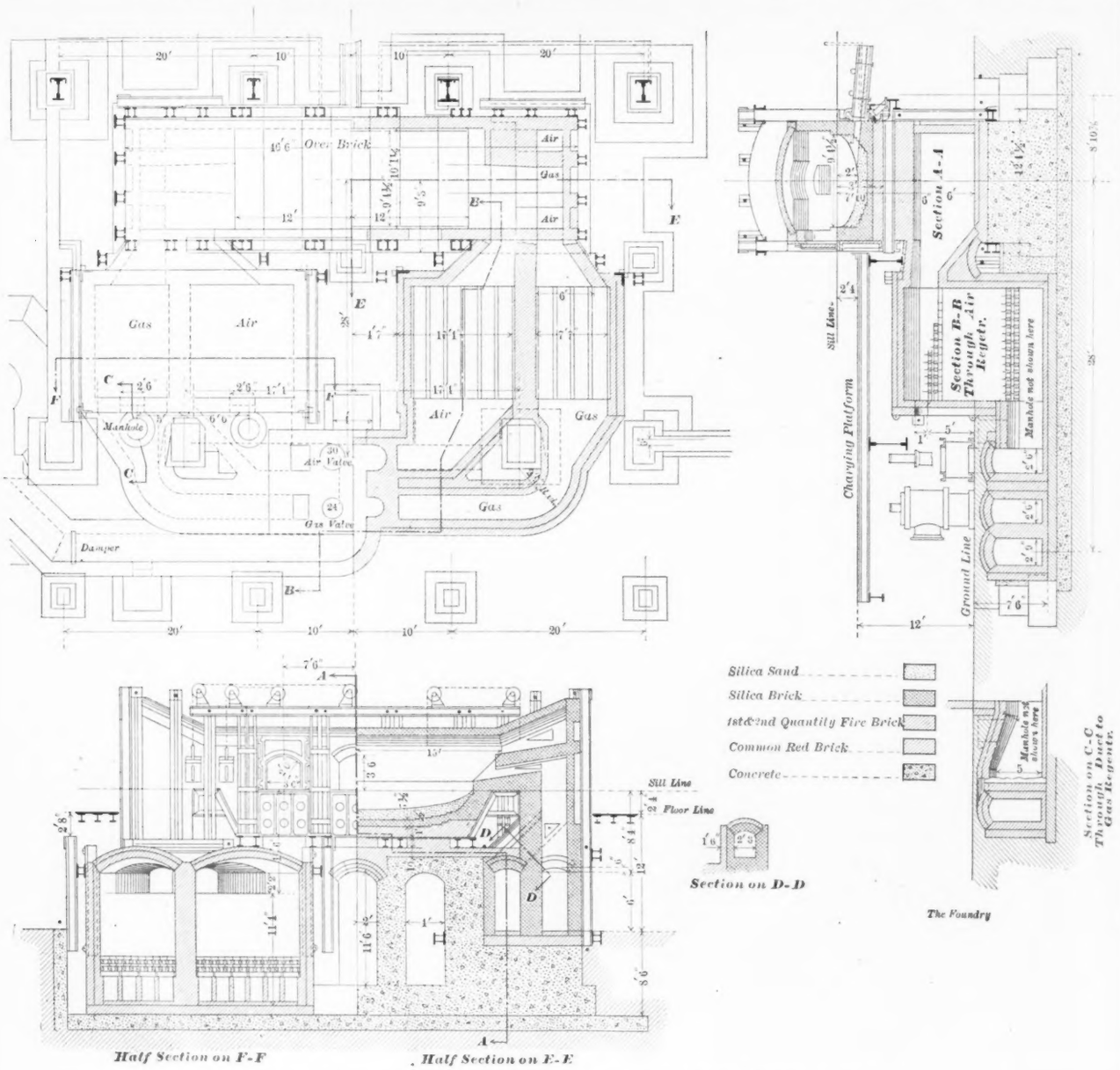


FIG. 4—PLAN AND SECTIONAL VIEWS OF THE ACID, OPEN-HEARTH FURNACE

cranes of 25 and 40 tons capacity each, installed by the Morgan Engineering Co., Alliance, O., and one of 50 tons capacity, built by the Alliance Machine Co., Alliance, O. In addition, two Morgan wall cranes are provided for handling flasks, rolling over molds, etc. The side bay in which the core ovens are located is commanded by two 5-ton Morgan cranes, while the yard between the foundry and machine shop is provided with a 25-ton crane, and the storage yard on the opposite side has a 15-ton crane which is used for unloading cars and handling the raw material for the furnaces in the foundry. Railroad tracks extend through both yards for incoming and outgoing shipments, and a track is laid into the foundry at one end, while another extends through the side of the building into the machine shop for the shipment of castings to this department.

FIG. 5—PATTERN STORAGE BUILDING, SHOWING THE OUTSIDE ELEVATOR AND BRIDGE FROM THE PATTERN SHOP

Casting Pit.

One of the features of the shop is the large casting pit located at one end of the middle bay near the open-hearth furnace which is used principally for casting rolls. The circular pit, 14 feet in diameter, has a depth of 27 feet, and the largest plate mill rolls now used can be molded and cast in the same. The oval pit which takes in the circular section referred to has a small diameter of 18 feet, a large diameter of 25 feet and is 14 feet deep. As the pit extends 7 feet below water level, it is enclosed by a steel tank protected on the outside

FIG. 6—PLAN VIEWS OF THE FIRST AND SECOND FLOORS OF THE CARPENTER AND PATTERN SHOP, SHOWING THE ARRANGEMENT OF THE WOOD-WORKING TOOLS

with concrete, and is lined on the inside with brick. When not in use the pit is closed with a large cast iron cover to prevent accidents.

Cupolas.

Iron is melted in two Whiting cupolas lined up to 72 and 46 inches respectively. The motor driven blowers installed by the Buffalo Forge Co., Buffalo, are located on a mezzanine floor 18 x 40 feet, directly in back of the cupolas, thereby reducing the length of the blast pipes to the minimum. The piping is so arranged that the blast from two blowers can be directed into either cupola as desired. The cupolas with the machinery platform are shown in Fig. 9. The cupola charging platform is 60 x 35 feet and the coke, pig iron, scrap, etc., are loaded into buckets and pans in the yard, and are elevated to an outside platform by the yard crane, as shown in Fig. 8, where the charges are placed on trucks on which they are conveyed to the cupolas. One corner of this bay is reserved for the production of brass castings, bearings, etc., and the metal is melted in an oil fired, Schwartz furnace.

Open-Hearth Furnace.

At the opposite end of this bay is located a 25-ton, producer gas, acid open-hearth furnace shown in Figs. 3 and 4. The hearth is 30 feet long, 9 feet 4½ inches wide and 24 inches deep. The spout is about 12 feet above the ground level, obviating the necessity of placing the ladles in a pit when tapping. A charging machine is used for charging the furnace and the gas is generated in two gas producers.

Core Ovens.

Plan and sectional views of one of the four core ovens is shown in Fig. 7. They are operated in pairs, firing pits being located between each pair to which access is had from the outside of the building, coke being used for fuel. Each oven is 20 feet wide, 24 feet long and 10 feet high, and is equipped with a Kinnear rolling door. Two tracks extending into the middle bay lead into each oven, in which four large core oven cars can be placed. These trucks and buggies, which can be arranged for large and small cores, were installed by the Whiting Foundry Equipment Co., Harvey, Ill. The heat is distributed through large flues covered with perforated plates placed underneath the tracks on which the core buggies operate.

The sand mixing equipment is located in a building adjoining the foundry, this department being 39 x 34½ feet in size. The sand bins are in a covered structure, an extension to the sand mixing building, and have a capacity of 500 tons. The sand

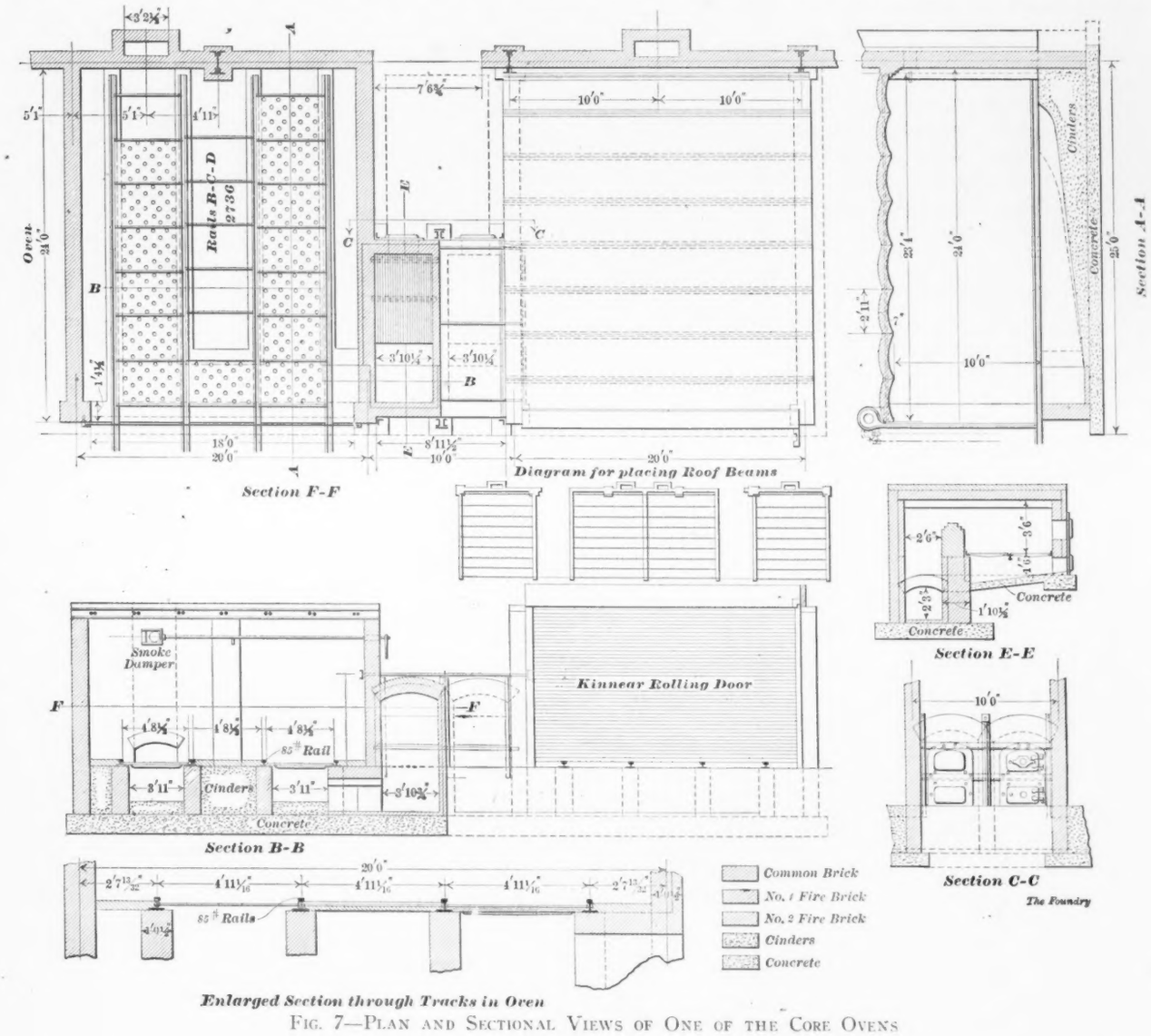


FIG. 7—PLAN AND SECTIONAL VIEWS OF ONE OF THE CORE OVENS

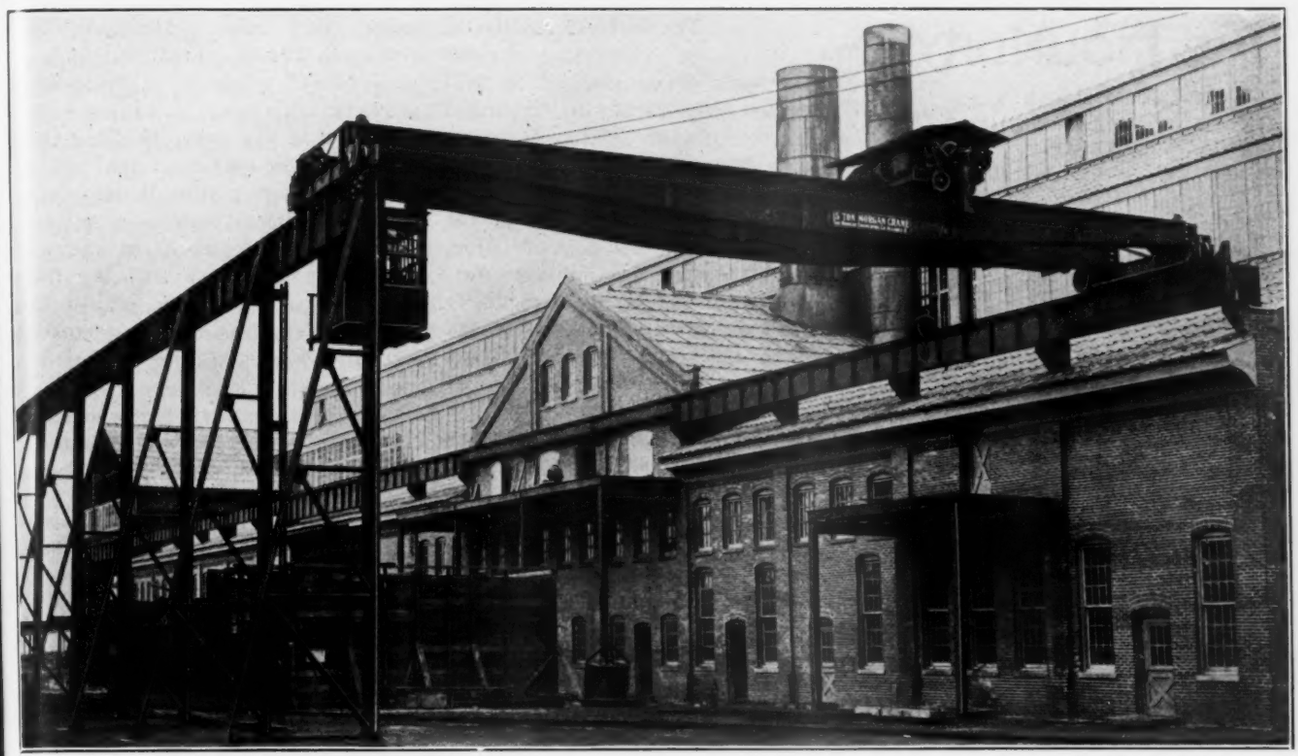


FIG. 8—PIG IRON, SCRAP AND COKE STORAGE YARD

bins extend a length of 75 feet on either side of this structure, the receiving track being located in the center.

The pattern and carpenter shop is a well-lighted, well-ventilated, two-story structure, built of steel and concrete, 99 feet 3 inches long and 51 feet 3 inches wide. The general arrangement of the first and second floors, on which are located the pattern and carpenter shops, respectively, is shown in Fig. 6. The woodworking tools in both departments are driven from motor-driven shafts and the tools are arranged lengthwise of the center of the building, within easy access of the carpenters and patternmakers. Considering the rough nature of the work done in the carpenter shop, the machine equipment is unusually complete. In the pattern shop the benches are arranged along both sides of the building directly in front of the windows, and with the exception of the large lathes, the patternmakers are in close proximity to all of the machines.

The pattern shop and pattern storage buildings are connected by a bridge, as shown in Fig. 5, thus affording easy communication between these departments, and facilitating the transferring of patterns from one to the other. The pattern storage is a four-story fireproof structure, 50 x 120 feet, and to further reduce the fire risk, there are no openings between the floors, which are reached by means of an elevator outside of the building, as well as an outside stairway. The plugs for lighting the various floors are all located outside the doors and none can be closed until the electric connection is broken, thus cutting off the flow of current in the wires on these floors when the doors are shut. All the shavings, dust, etc., from the pattern and carpenter shop are disposed of by a dust collector system, and are carried through a large discharge pipe from a point near the rear of the pattern building across the front of the electric light repair shop to the boiler room of the blacksmith shop.

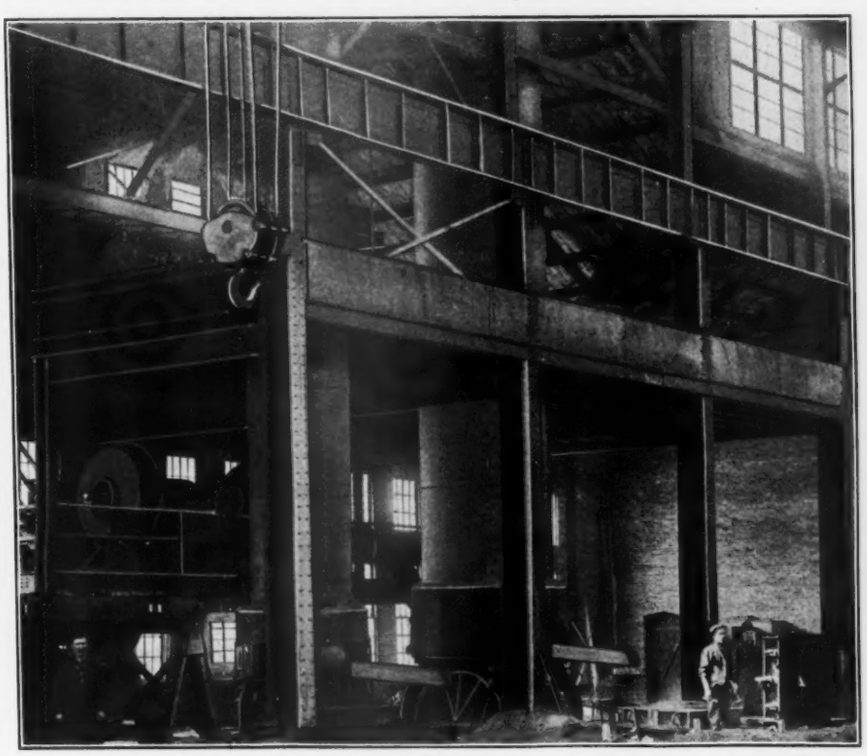


FIG. 9—THE CUPOLAS AND THE MEZZANINE FLOOR ON WHICH THE BLOWERS ARE LOCATED

THE FOUNDRY

PUBLISHED MONTHLY BY
THE PENTON PUBLISHING CO.
CLEVELAND.

BIRMINGHAM, ENG.....Prince's Chambers.
BUFFALO.....932 Ellicott Sq.
CHICAGO.....1328 Monadnock Block.
CINCINNATI.....First National Bank Bldg.
NEW YORK.....1005 West Street Bldg.
PITTSBURG.....510 Park Bldg.
SEATTLE.....302 Pioneer Bldg.

Copyright, 1909, by Penton Publishing Co., in the United States and Great Britain.

The subscription price of THE FOUNDRY is $1.00 a year in the United States and Mexico. To Canada, $1.50. To Great Britain, Eight Shillings. Single copies, 15 cents each.

Change of advertising copy must reach this office on the 10th of the month preceding date of publication.

The Cleveland News Company will supply the trade with THE FOUNDRY through the regular channels of the American News Co.

European Agents: The International News Company, Breams Building, Chancery Lane, London, E. C., England.

PAID CIRCULATION OF THE FOUNDRY

January	9,143
February	9,305
March	9,516
April	9,702
May	10,023

Entered as second-class matter at the Post-Office at Cleveland, Ohio.

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The Foundrymen's Convention

The interest manifested in the foundrymen's convention, which will be held in Cincinnati May 17 to 22, foreshadows a large attendance, and several powerful foundry trade organizations, not directly affiliated with the American Foundrymen's Association, will hold their regular meetings during this week to permit their members to attend the business sessions of the various allied bodies and to inspect the exhibits of foundry supplies and equipment, which promise to be unusually complete. Practically all of the available space in Music Hall and the adjoining temporary building has been reserved, and molding machines adapted for all classes of foundry work will be shown in operation, while the molds will be poured with the metal melted in the furnaces that will be displayed. Many foundrymen are preparing to send their superintendents and foremen, and several large manufacturers will send a number of apprentices, realizing that this exposition of foundry appliances will afford them opportunities to acquaint themselves with the latest developments of foundry practice. Notable advances, particularly in molding methods, have been recorded during the year and practically all of the machines that have made this progress possible will be exhibited.

A Sinister Record

Figures compiled by a jobbing foundryman, statistically inclined, located in one of the leading iron and steel centers, indicate that the business in which he is engaged is an exceedingly precarious one. During the past eight years he has kept a record of the failures as well as the number of concerns that have engaged in this line but have discontinued operations for various reasons. The figures are startling as they show that no less than 47 gray iron jobbing foundries, within a radius of 10 miles of his shop, passed out of existence in that period, 46 remaining to contest the field today. In this total are included reorganizations and sales of shops via court proceedings, many of the plants that originally failed to produce dividends being in successful operation at present under new management. An investigation of the affairs of these concerns would undoubtedly have disclosed much valuable information anent methods that should wisely be avoided and it can safely be assumed that the rocks on which they foundered were labeled "Lack of System" and "Failure to Maintain Accurate Costs." The business itself if properly conducted is no more precarious than any other line and there are many jobbing shops that are returning larger profits in proportion to the investment than many specialty plants generally considered the gold mines of the foundry trade by those not conversant with the pitfalls that beset their successful operation. With few exceptions, the lowest prices during periods of keen competition are named by foundries in which the costs of production are merely rough estimates at best, and they are generally so poorly equipped that their labor charges alone, were they accurately known, would represent the major portion of the quotations made. While it is generally admitted that the maintenance of a correct record of costs in the jobbing trade, on account of the variety of work offered from day to day, is a difficult problem, nevertheless, there are many simple systems that can be successfully applied to the peculiar requirements of this business, which will insure fair prices during periods of the most strenuous competition.

Trade Outlook

The marked revival in the demand for iron and steel products, recorded during the last 30 days, has been favorably reflected in the foundry trade, and the melt in iron, brass, steel and malleable foundries is rapidly increasing. The heavy buying of pig iron has had a tendency to strengthen prices, and while there have been no sharp advances, quotations, particularly in the south, that represented producing costs, have been withdrawn. Manufacturers of foundry supplies, without exception, report increased sales in April as compared with the same month a year ago, and this indicates a healthy improvement in all branches of the foundry industry. The railroads are still buying sparingly and are not placing equipment orders of any consequence. Implement makers are, however, furnishing the malleable foundries a comfortable tonnage, and the output of these shops has shown a big increase. The low prices of structural material have resulted in the placing of contracts for many large building projects, and the producers of plumbers' supplies and builders' hardware are operating their shops at increased capacity to meet these requirements. Foundry stocks of pig iron are low and while numerous orders are being

placed, few are of such a size as would indicate buying for future needs. In the south, $11.00 for No. 2, Birmingham, is the minimum, and $11.50 and $12.00 are being named by a few interests. In the Mahoning and Shenango Valleys the furnaces are quoting $14.00 for No. 2, and in the Cleveland district, $14.50 is asked. In the Philadelphia and Chicago districts No. 2 is being sold on the basis of $16.25 to $16.50, and Lake Superior charcoal is held at $19.50, Chicago. The reaction in the iron and steel trade which followed the panic of 1907 is shown in the following figures compiled by the American Iron and Steel Association:

Production, in gross tons, except Connellsville coke, which is in net tons.	1907.	1908.	Percentage of decrease.
Pig iron	25,781,361	15,936,018	38.1
Bessemer steel	11,667,549	6,116,755	47.5
Open-hearth steel..	11,549,736	7,836,729	32.1
Rails	3,633,654	1,921,611	47.1
Structural shapes..	1,940,352	1,083,181	44.1
Shipments, Lake Superior iron ore..	42,266,668	26,014,987	38.4
Shipments, Connellsville coke	19,029,058	10,700,022	43.7
Locomotives built..	7,098	2,124	70.0
Cars built	280,380	69,594	75.1
Iron and steel vessels built	157	99	36.9
Miles of steam roads built	5,499	3,214	41.5

PERSONAL.

A. E. Domville, who, for the past four years, has been in charge of the wheel foundry of the American Car & Foundry Co., Berwick, Pa., has been appointed superintendent of the foundries operated by this concern located in the Berwick district.

C. H. Jenkins, secretary of the Domhoff & Joyce Co., Cincinnati, pig iron merchants, has been placed in charge of the Chicago office of this concern.

Robert J. Gardner has been appointed general superintendent of the S. Jarvis Adams Co., Midland, Pa.

Frederick G. Grumme, secretary and manager of the Decatur, Ind., plant of the Portland Foundry & Machine Co., Portland, Ind., has removed to Robinson, Ill., to take charge of the foundry built by this concern at that place.

George Thompson has resigned as general superintendent of the Kankakee Foundry Co., to take charge of the Gartland Foundry at Marion, Ind.

Robert Thurston Kent has resigned as engineering editor of *The Iron Trade Review*, Cleveland, to become managing editor of *Industrial Engineering*, Pittsburg, a new publication, devoted to mechanical engineering subjects.

Wm. H. Goldstine, formerly superintendent of the foundry of the Norwalk Brass Co., Norwalk, Conn., has been appointed superintendent of the aluminum and brass foundries of the Buick Motor Co., Flint, Mich.

J. P. Pero, formerly superintendent of the Canadian plant of the Pratt & Letchworth Co., Brantford, Ont., has been appointed superintendent of the Missouri Malleable Iron Co., East St. Louis, Ill.

C. B. Goodspeed has been placed in charge of the Chicago office of the Buckeye Steel Castings Co., Columbus. He is a son of the late W. F. Goodspeed, founder of this concern, and is a director of the corporation.

J. T. Miller, superintendent of the Scottdale Foundry & Machine Co., Scottdale, Pa., has resigned to accept the position of superintendent of the Connellsville Iron Works, Connellsville, Pa.

Hugh McPhee, who has just completed the installation of a brass foundry for the Buick Motor Co., Flint, Mich., has been appointed superintendent of the plant operated by the Edna Smelting & Refining Co., Cincinnati.

George Thompson, who until recently was associated with the Kennedy Valve Co., Elmira, N. Y., is now connected with the Chapman Valve Co., Indian Orchard, Mass.

It was erroneously reported in the April issue of THE FOUNDRY that Arthur Simonson, who severed his connection with the Tropenas Steel Co., New Castle, Del., had disposed of his interest in that concern. We have been advised that he possessed no stock in this corporation.

Thomas D. West has severed his connection with the Thomas D. West Foundry Co., Sharpsville, Pa. On Wednesday evening, April 14, the citizens of this community held a farewell meeting in Mr. West's honor, which was largely attended. The employes of the Thomas D. West Foundry Co. presented Mr. West with a handsome loving cup, and numerous gifts were also given to Mrs. West. Mr. West will associate himself with his son, who is president of the West Steel & Iron Casting Co., Cleveland, and he will now have more opportunity for extending the interest in and carrying out the aims and objects of the American Anti-Accident Association. Frank Ticknor of the Lackawanna Steel Co., Buffalo, has been appointed to succeed Mr. West.

David Spence has been placed in charge of the Essex Foundry, Newark, N. J. Soil pipe, steam fittings, sinks, etc., are manufactured.

J. C. Bunger has been appointed manager of the Washington foundry operated by Henry Orme's Sons Co., St. Paul, Minn. Mr. Bunger was formerly with the A. E. Shorthill Co., Marshalltown, Ia.

FIFTIETH ANNIVERSARY OF P. H. & F. M. ROOTS CO.

The P. H. & F. M. Roots Co., Connersville, Ind., manufacturer of rotary, positive-pressure blowers, gas exhausters, pumps, etc., recently celebrated its fiftieth anniversary. Half a century ago, two brothers, Philander H. and Francis M. Roots, then operating a woolen mill by water power, conceived the idea of using the rotary pump principle in a water motor and one was built of wood, including the case and impellers, with the exception of the shafts and bearings. The machine naturally swelled on being introduced to its driving element, and it was taken to a small stove foundry for repairs. When it was tested with a belt drive the foundryman noticed the air issuing from the discharge side and remarked that he believed the machine would melt iron. The suggestion was immediately acted upon, and the first of the Roots blowers was built and placed in successful operation. While the clearances were liberal, the type, with minor modifications, endures today. Changes in impeller forms, modification in bearing designs, convenience of adjustments and standardization are all improvements that might be said to be due to the improvement in shop methods and machine design, making the close clearances of the present day type not only possible but practical.

The original use of the blower for foundry work soon ceased to be the only field, and it was later used as a foul gas exhauster, and copper blast furnaces next furnished the incentive for better machines for heavier work. Then followed its application to trunk line distribution and high pressure pumping. The latest application is for vacuum cleaning machines.

The business has always been in the hands of the original Roots Brothers, or their descendants, just as the design has varied little from the original conception.

James Bennie & Sons, proprietors of the Clyde Engine Works, Cardonald, near Glasgow, Scotland, have concluded a license with the Hanna Engineering Works, Chicago, for manufacturing the Hanna type of pneumatic riveter in Great Britain.

FOUNDRY & PATTERN SHOP EQUIPMENT

Power-Ramming, Rock-Over Molding Machine---Sand Mixing Machine --- The Wadkin Wood-Worker --- Core Oven --- Foundry Riddle

THE pneumatic power-ramming, rock-over molding machine shown in the accompanying illustrations combines two essential features of mechanical molding that entirely eliminate skilled labor or hand ramming in the production of a mold, and in addition it greatly facilitates operations. The location of the cylinders above the pattern frame, which permits of the ramming of the mold with the downward stroke of the pistons, is another unique feature embodied in this machine.

Referring to Fig. 1, it will be noted that the cylinders are supported on two cast steel uprights, counterbalanced by springs to facilitate the forward movement of the cylinders to the vertical ramming position over the flasks. The cylinders are 8 inches in diameter by 5-inch stroke, and each is operated by an independent valve. Each cylinder is also provided with a gage which immediately indicates the ramming pressure exerted on the sand. The pistons return to their normal position automatically, thereby eliminating one movement of the operator, and they are returned to position for ramming the next mold. The two cylinders are bolted together and in turn are bolted to the steel uprights which swing on a shaft on the frame.

The cast iron pattern frame is counterbalanced with two springs to facilitate the rocking-over movement of the mold, preparatory to drawing the pattern, and the machine is also provided with a 3-inch drop frame, operated by a step on either side, which drops the mold away from the pattern, the pattern-drawing operation being completed by the rocking back of the pattern frame.

The flask rests on which the molds are deposited when rocked over are automatic leveling devices, which adjust themselves to the bottom boards at four points. The vibrator is operated automatically, a lug on the pattern frame depressing a pin in the machine frame which opens the valve on the vibrator when the pattern frame is rocked over. When the pattern frame is swung back the valve is closed automatically and the vibrator ceases operation. The machine is mounted on three wheels, one in front and two in the rear, provided with ball bearings, which are adjusted in such a way that the machine can be moved only lengthwise of the floor, following the sand pile as the day's work progresses.

In Fig. 1 the machine is shown with the flasks in position on the cope and the drag patterns, match plates being used, which are bolted to the pattern frame. The flasks have already been filled with sand and the bottom boards adjusted. In Fig. 2 the cylinders have been swung forward in a vertical position over the

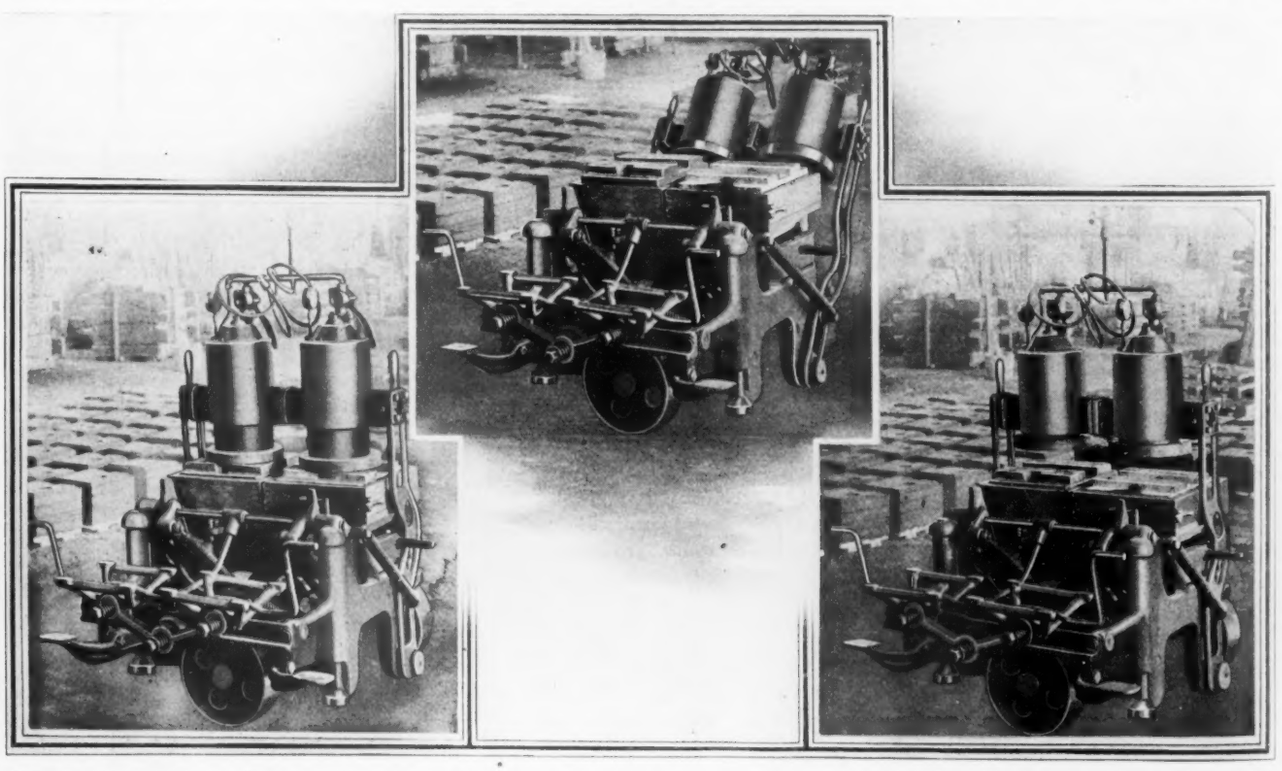


FIG. 2—CYLINDERS IN VERTICAL POSITION AND THE MOLDS ARE BEING RAMMED BY THE DOWNWARD STROKES OF THE PISTONS

FIG. 1—POWER-RAMMING, ROCK-OVER MOLDING MACHINE, FLASKS FILLED WITH SAND AND BOTTOM BOARDS ADJUSTED

FIG. 3—THE PISTONS IN NORMAL POSITION TO WHICH THEY HAVE AUTOMATICALLY RETURNED

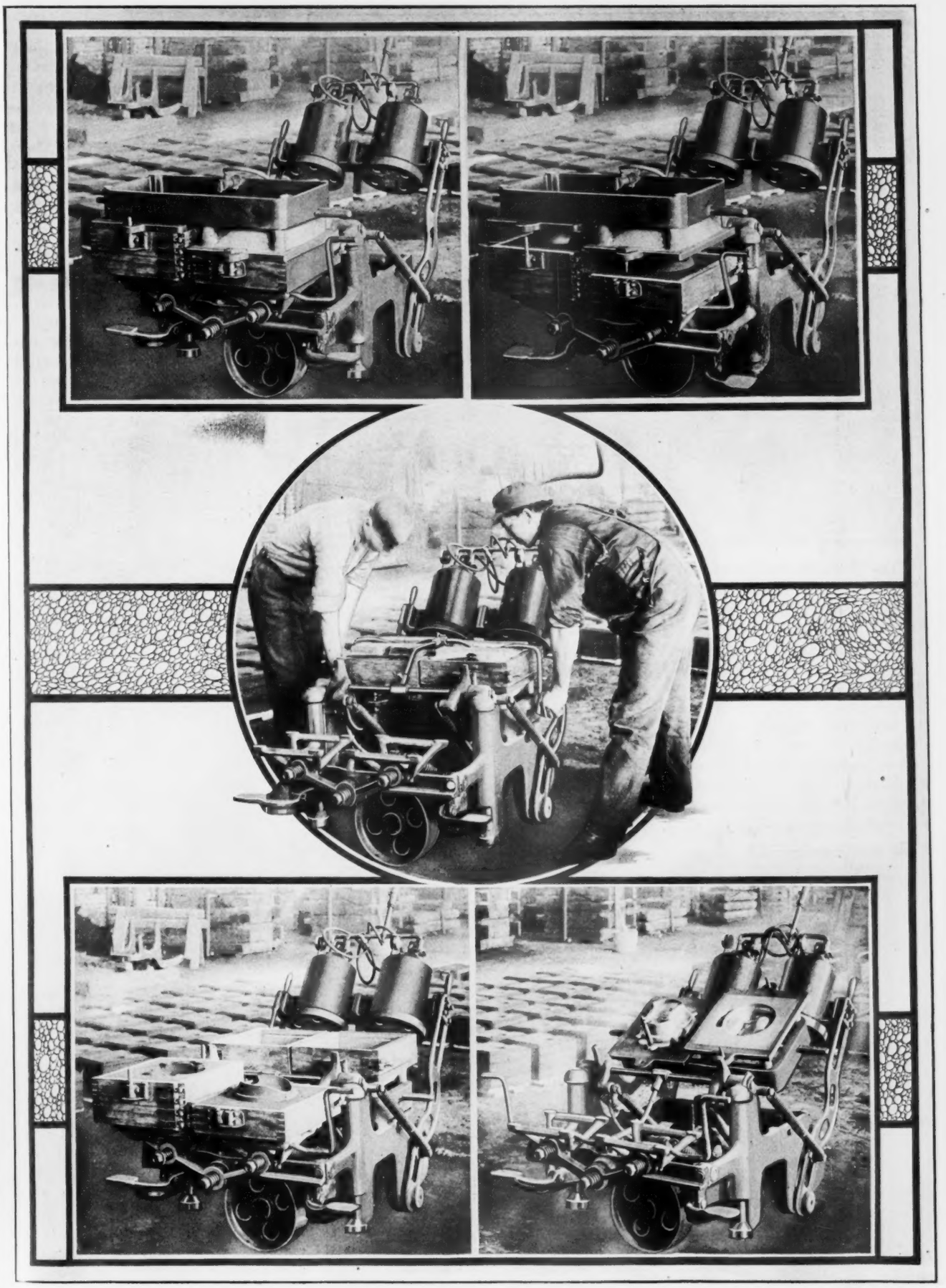


FIG. 5—RAMMING HEAD SWUNG BACK; THE MOLDS HAVE BEEN ROCKED OVER AND ARE RESTING ON THE LEVELING DEVICES

FIG. 6—THE MOLDS DROPPED AWAY FROM THE PATTERNS

FIG. 4—THE OPERATOR AND HELPER CLAMPING THE FLASKS

FIG. 7—PATTERN FRAME ROCKED BACK SHOWING COPE AND DRAG MOLDS ON THE LEVELING DEVICES

FIG. 8—VIEW OF THE MATCH PLATES ON THE PATTERN FRAME

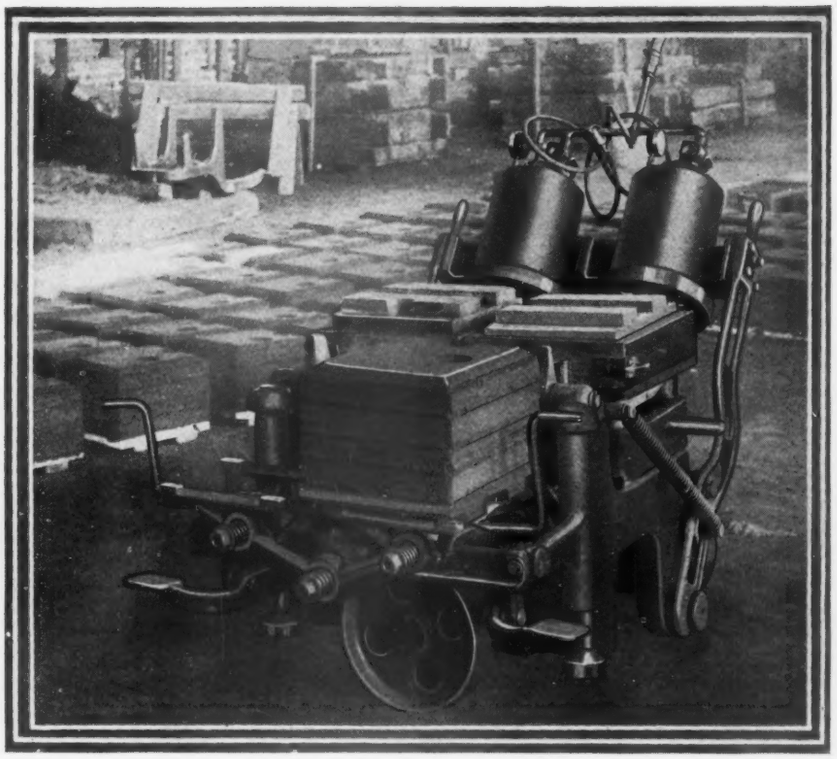


FIG. 9—MOLD CLOSED READY FOR REMOVAL BY THE HELPER. IN THE MEANTIME THE OPERATOR HAS FILLED ANOTHER SET OF FLASKS WITH SAND, ADJUSTED THE BOTTOM BOARDS, AND THE MOLDS ARE READY FOR RAMMING

flasks, and the cope and drag halves of the mold have been rammed by the downward strokes of the piston. In admitting the air to the cylinders, the levers are opened and closed by the operator and his helper, the former operating the machine while the latter closes the molds, places them on the floor, operates one lever for ramming and aids in clamping the molds while rocking over. In this view the pistons are shown in their lowered position, while in Fig. 3 they have returned automatically to their normal position.

In Fig. 4 the operator and his helper are clamping the molds by grasping the handles on either side of the clamp, as well as the handles on the pattern frame. This obviates the use of a mechanical clamping device, and further reduces the operations required for making the mold. It will also be noted that the ramming head has been swung back out of the way. The cope and drag halves of the mold and the pattern frame are shown rocked over in Fig. 5, the flasks resting on the leveling devices, which automatically adjust themselves to the bottom boards. In Fig. 6 the molds have been dropped away from the patterns by depressing one of the steps at the side of the machine which actuates the drop frame.

The pattern frame with the match plates is then rocked back, another set of flasks placed in position, and the operator proceeds with another mold as shown in Fig. 7. The pattern frame, rocked back half way, showing the aluminum match plates, is illustrated in Fig. 8. The sprue is bolted to the cope plate and is cut when the mold is rammed. The operator's helper then closes the mold and removes the flasks as shown in Fig. 9, while the operator fills the flasks on the pattern frame with sand and adjusts the bottom boards preparatory to ramming another mold.

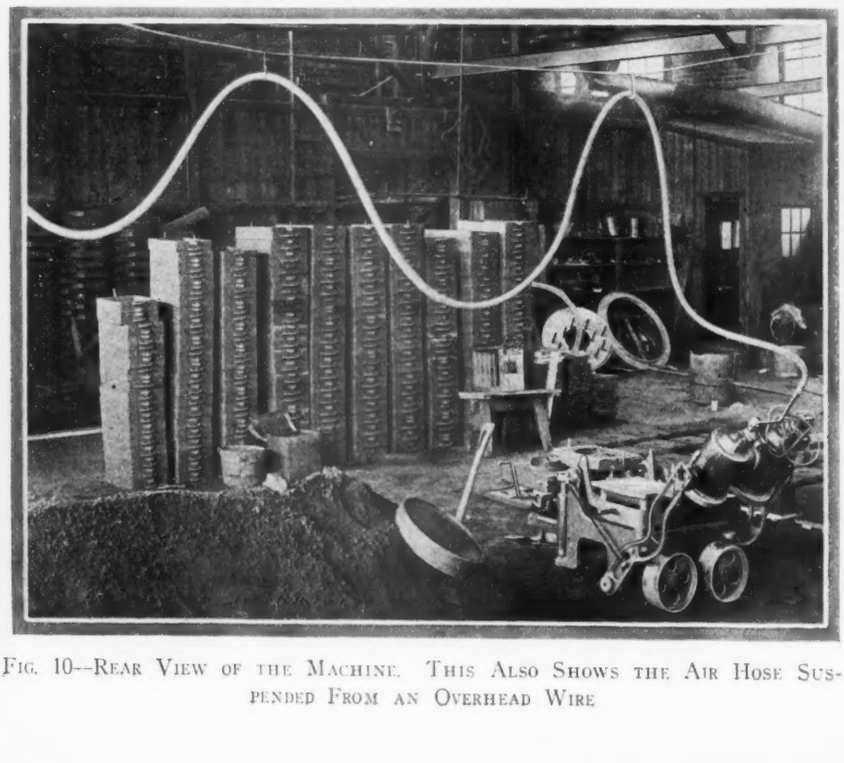


FIG. 10—REAR VIEW OF THE MACHINE. THIS ALSO SHOWS THE AIR HOSE SUSPENDED FROM AN OVERHEAD WIRE

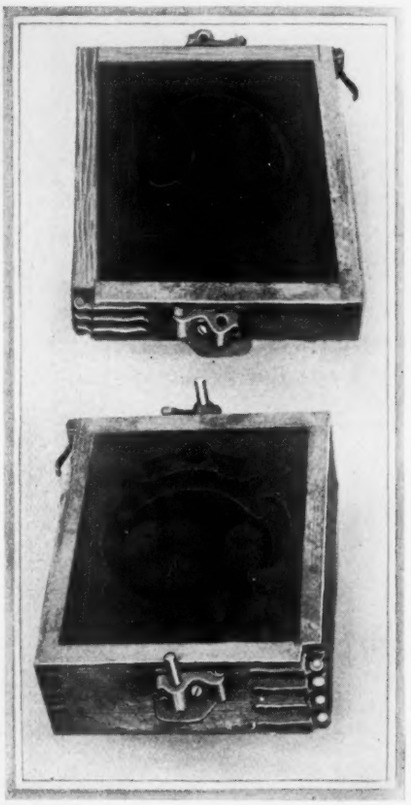
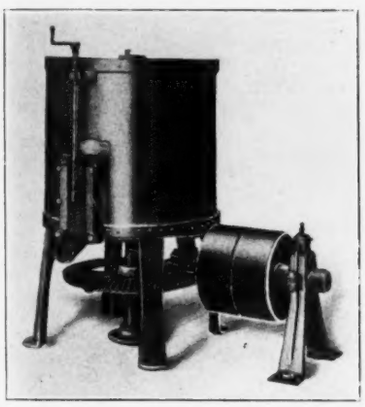


FIG. 11—DRAG AND COPE HALVES OF THE MOLD MADE ON THE POWER-RAMMING, ROCK-OVER MOLDING MACHINE

After the helper sets the first mold on the floor he returns to the machine and operates one of the levers of the two ramming cylinders, and the same sequence of operations follows as in making the first mold.

The pattern shown on the machine in Fig. 8 is the base of a peanut vending machine, a difficult casting to make, which weighs about five pounds. Made on the bench, the molders are paid 5 cents for each casting, 80 constituting a day's work, whereas, on this machine an operator and helper can produce from 90 to 100 molds an hour. On work similar to this, the machine has a capacity of 425 molds in 6½ hours. When the work is not too deep, the machine can be operated at a pressure of 35 pounds and can handle flasks, 12 x 18 inches and 12 inches deep.

It will be noted that owing to the extremely irregular parting, the cope is much deeper than the drag, and the match plates are so constructed and mounted on the pattern frame that the flasks are on a level when struck off. The drag half of the mold is shown in the upper view, Fig. 11, and the cope is illustrated below. A rear view of the machine, showing the cylinders swung back, as well as the two rear wheels, is shown in Fig. 10. The air hose is suspended from an overhead wire, which keeps the hose out of the sand and does not interfere with the operator. This arrangement has proven exceedingly satisfactory and has resulted in greatly increasing the life of the hose. This machine is manufactured by Henry E. Pridmore, molding machine manufacturer, Chicago.



CLEVELAND BLACKING MIXER

THE CLEVELAND BLACKING MIXER.

The blacking mixer shown in the accompanying illustration, manufactured by the J. D. Smith Foundry Supply Co., Cleveland, insures an unusually uniform and homogeneous mixture of wet blacking, which can be tapped out of the tank while it is in operation. The mixture is made in a steel tank having a capacity of 60 gallons, which operates at a speed of only 35 revolutions per minute. The mixture is agitated by a series of revolving paddles mounted on a shaft, protected from the liquid by a sleeve. The paddles keep the mixture in every part of the tank thoroughly stirred and prevent the collection of sediment around the bottom edges. The machine is belt driven and requires only ¾-horsepower to operate.

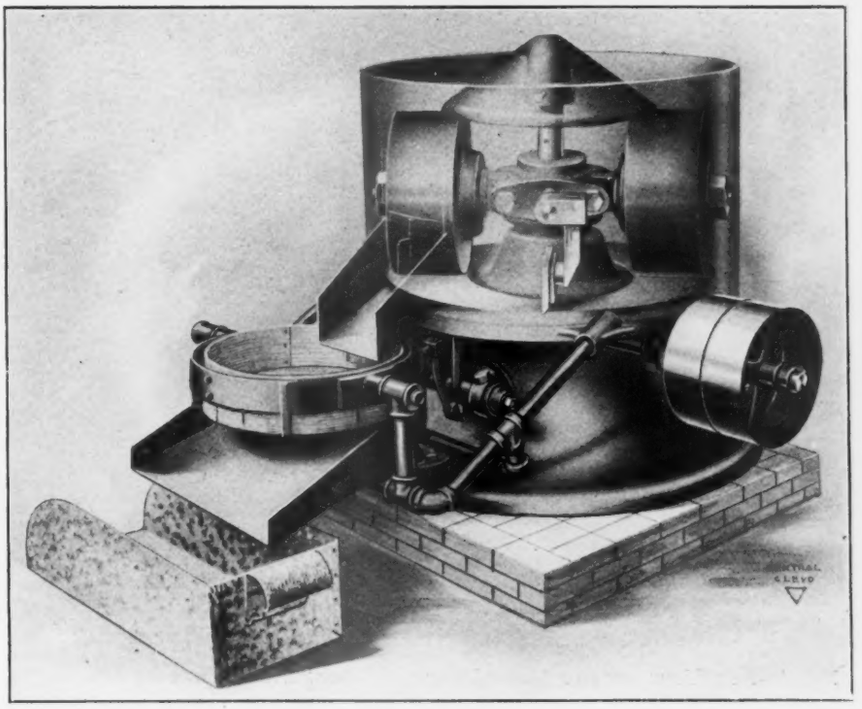


FIG. 1—THE WADSWORTH SAND MIXING MACHINE

THE WADSWORTH SAND MIXING MACHINE.

The mixing and blending of core sand is one of the difficult problems which must be solved in every foundry, and in most shops where small cores are made, the sand is required in small batches either for the core machine or the bench workers. It has been found that a considerable saving may be effected in the amount of binder required if the core sand is ground, and the machine shown in Figs. 1 and 2 has been especially designed for this work. It is essentially a roller mill in which two rollers weighing several hundred pounds each, travel in a circular path upon a cast

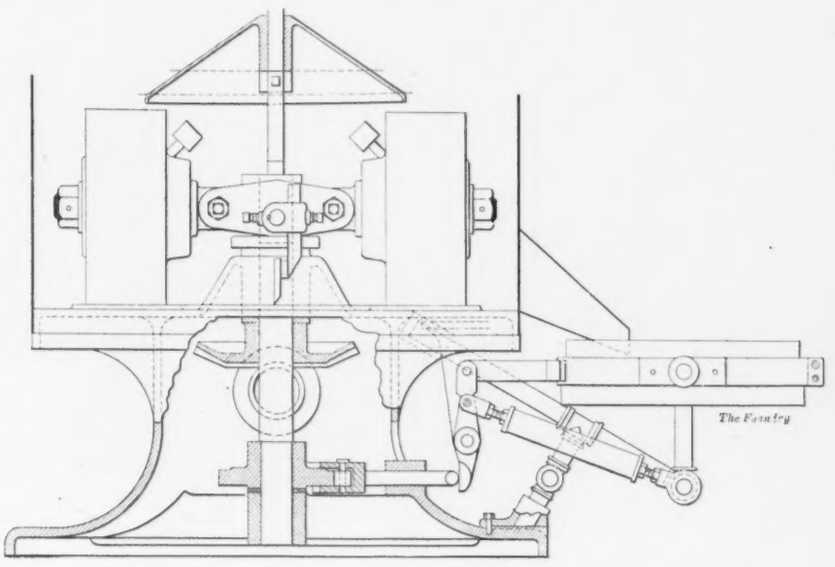


FIG. 2—SECTIONAL VIEW OF WADSWORTH SAND MIXING MACHINE

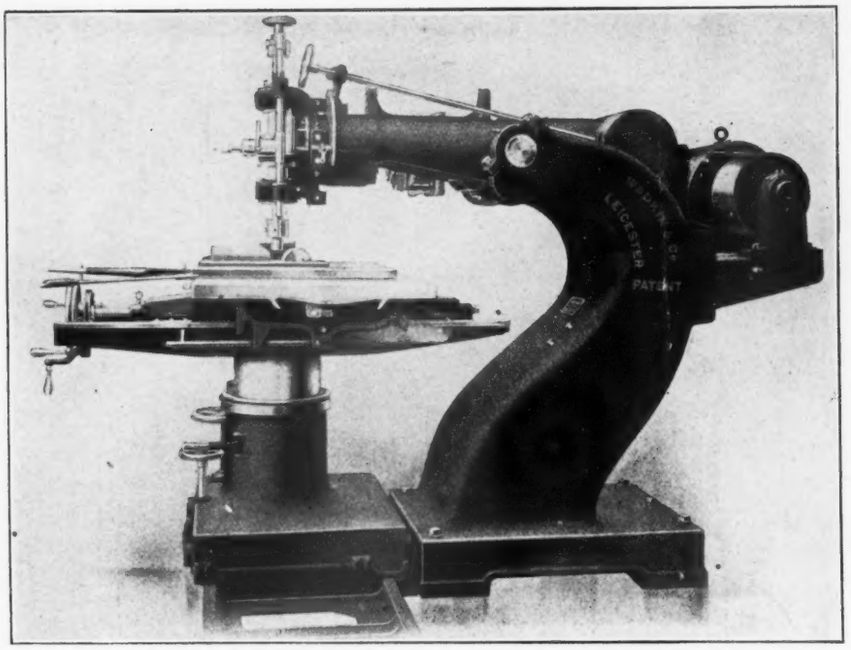


FIG. 1—SIDE VIEW OF THE MOTOR-DRIVEN, WADKIN WOOD-WORKING MACHINE

iron base plate, the rollers being driven from the pulley shown in Fig. 1, by means of a vertical shaft and a set of bevel gears.

The cone, which is clearly shown above the casing surrounding the machine, distributes the sand when it is shoveled into the mill so that it will fall where it will be immediately acted upon by the rolls. It also protects the upper bearing of the shaft carrying the roller mechanism, the cone being attached to the latter and revolves with it. Between the rolls are two scrapers which throw material from the edges of the pan underneath the rollers. A batch of material is dumped into the machine while it is in motion and is ground with the addition of the necessary binding material. If flour is used, it is mixed with the sand when it is first introduced into the machine, and if core oil is being used, this is added next and the required amount of water is added last to the mixture.

Two distinct types of binders, particularly in mixtures for core machine work, have always been recommended by Geo. H. Wadsworth, designer of the mill. For holding the sand together previous to baking he has recommended a binder such as flour, and for holding the sand together after baking the use of core oil, linseed oil, glutrin or some other liquid compound. The mixture used for making machine cores consists of 12 quarts of sand, one-half pint of boiled linseed oil and two quarts of flour. Silica dust has also been used with good results. By the use of this mill it has been found possible to reduce the amount of flour or silica dust required by one-half, but the amount of oil binder necessary, remains the same. This mixture is, however, made entirely of new sand, and if old sand is used it is probable that some of the binder remaining in it would become operative through grinding and would reduce the amount of new binder necessary.

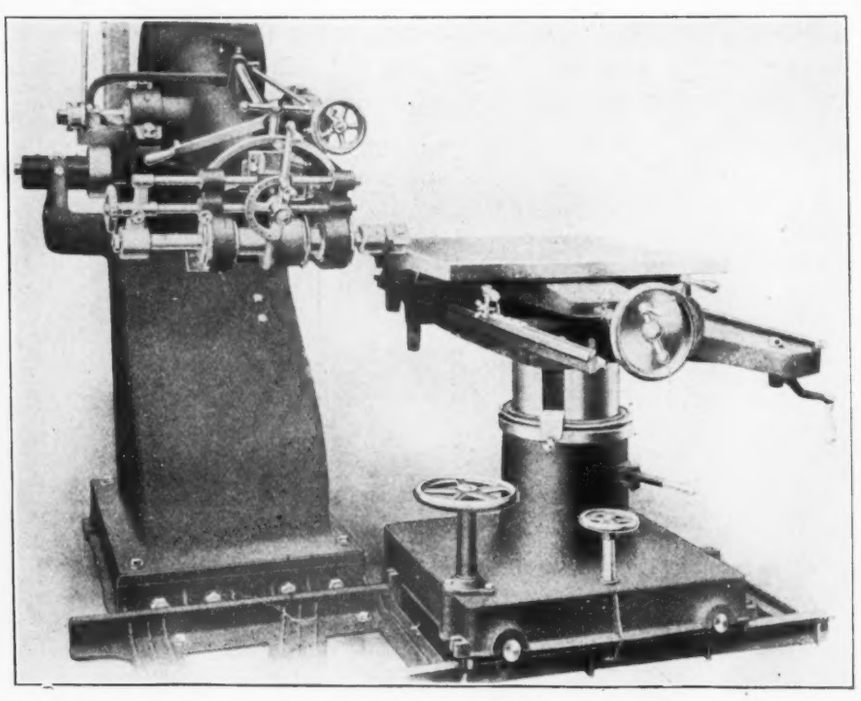


FIG. 2—FRONT VIEW OF BELT-DRIVEN MACHINE WITH SPINDLE CHANGED FROM VERTICAL TO HORIZONTAL POSITION AND ROCKING HEAD LOWERED

The silica dust referred to is a fine powder washed or blown out of the silica sand and quarries in northern Ohio, and it is stated that it has remarkable binding qualities, being similar to the magnesia core sand mined in Illinois. In grinding silica sand of this kind, the rolls of the mill should not be of such a weight as to crush all of the grains to powder, and in designing this machine the rolls were made much lighter than those employed in clay mills.

When making a core mixture with a shovel and power riddle, it will require one man practically 20 minutes to mix a batch of 12 quarts of sand. When mixed in the mill, the sand is ground and thoroughly mixed in about five minutes, and it is claimed that the resulting product is more uniform and better adapted for the work for which it is required. After the charge has been mixed the gate in the casing of the machine is opened and the scrapers and rollers force the charge into the spout, from which it falls into the riddle. The latter is only operated while the machine is discharging, its operating mechanism being held out of contact with the cam at other times by means of a clamp controlled by a conveniently located wheel. The riddle is of the ordinary type and fits loosely in the frame. This results in making the riddling of the mixture more rapid and effective, as it is similar to the rapping action of the operator when riddling by hand.

The receiving box into which the mixture is discharged is constructed in the form of a sheet iron scoop so

that the mixture may be carried to the core maker's bench, or dumped into the hopper of the core machine without further handling. About one horsepower is required to operate the mill and it will be built both with and without riddle attachments, so that shops having power riddle installations can use them in connection with the mill. This machine completes the lines of core room equipment designed by Geo. H. Wadsworth, and is built by the Falls Rivet & Machine Co., Cuyahoga Falls, O.

THE WADKIN MECHANICAL WOOD-WORKER.

The Wadkin mechanical wood-working machine, shown in the accompanying illustrations, compares favorably with the universal milling machine, and by its construction it embodies several movements that cannot be made on the latter, such as the canting of the spindle head, its great range of adjustment vertically by the elevation and depression of the rocking arm, and the extended range of adjustment of the table frame, laterally. The movements of this machine are particularly well adapted to the irregular work of patternmaking, and being easily adjusted, it lends itself conveniently to the constantly varying demands of the pattern shop, where repetition work is the exception rather than the rule.

Capacity of the Machine.

A few of the important operations in pattern and core box work that can be performed on this machine are as follows: Core boxes, regular and irregular in section; square bends, tees, socket ends, valve and pump boxes, etc., up to 12 inches in diameter; recessing and routing heavy bodies; cross grooving, trenching, halving and jointing; rounding curves and shaping U, D and C sections; truing built-up pieces direct from the saw; boring and slotting large holes at any angle; molding straight or curved arms of wheels and shaping the bosses for the same; spiral and ornamental work of any geometrical design; cutting fillets, straight or curved; cutting dowels crosswise of the grain; cross-cutting any length and width up to 2 feet 6 inches; dovetailing right and left hand sets at one setting; boring up to 6 inches diameter, or any larger size, by rotating the table; slot mounting and recessing any length and up to 6 inches width of slot; gear cutting, etc.

A side view of the motor-driven machine is shown in Fig. 1, and a front view in Fig. 2, with the spindle changed from vertical to horizontal position, the rocking head lowered and the table and table frame moved from underneath the rocking head. The overhanging arm carrying the spindle head rocks vertically on sensitive bearings and can be depressed at any angle below the level of the table. It has an exceptionally long overreach clear of the main frame. The spindle head swivels from a vertical to a horizontal position. The cutter spindle has a reversing motion and can be operated in any angular position between the vertical and horizontal. It is, furthermore, free to slide independent of any movement of the head, and is fitted with a quick-acting, positive attachment, as well as slow screw adjustment. A registering scale is fitted to the slide with screw adjustment giving the depth of cut. The swiveling motion is also provided with a graduated scale for setting to any desired angle of cut.

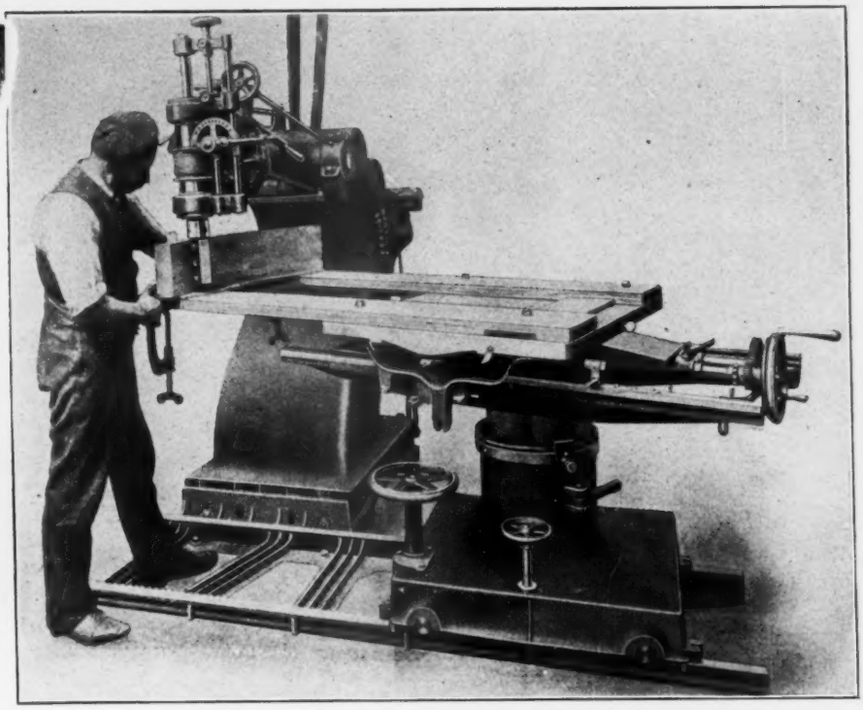


FIG. 3—OPERATING ON LARGE, SECTIONAL RADIUS WORK

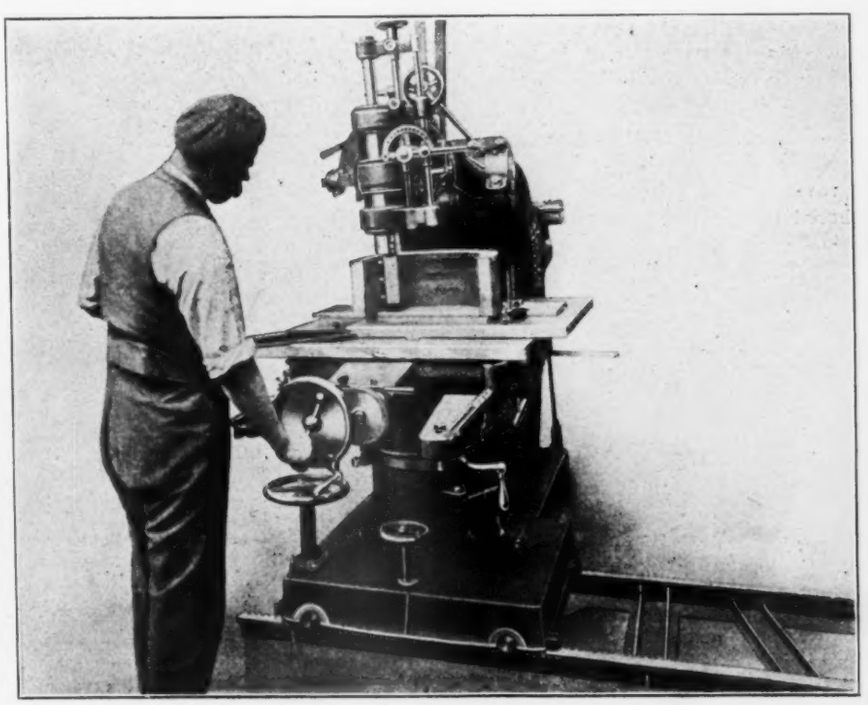


FIG. 4—FINISHING THE INSIDE OF A SWEEP TO A RADIUS OF FOUR FEET

The table frame moves on rails and is actuated by a hand wheel. It can be moved across the front of the machine from underneath the cutter spindle clear of the machine head, in which position the spindle head can be lowered under the level of the table top. In addition to the lowering movement of the table frame, the table is provided with a longitudinal and cross motion moving upon a sensitive ball race. It is quickly actuated, either by hand or by a positive screw and rack motion. It can also be raised and lowered and will turn through a complete circle horizontally. It can be moved around to work lengthwise, crosswise or at any angle, as desired.

The turning of the table and the swiveling of the head can be readily effected. The work need only be roughly set and the fine adjustments can afterwards be made. The motion of the spindle can be reversed when working in any angular position. The spindle is made of forged steel and is provided with a base at one end and bored to take Morse tang cutter holders, slot mortising bits, etc. It has a hardened face and a soft center and is ground accurately to gage. A loose spindle is fitted to take ordinary molding cutter blocks, tenoning heads, saws, disc cutter heads, etc. The cutter spindle runs in special, double race ball bearings, the cones of which are ground to fit the spindle in such a manner that the spindle itself receives no wear. The operating levers are fixed upon the machine head within easy access of the operator.

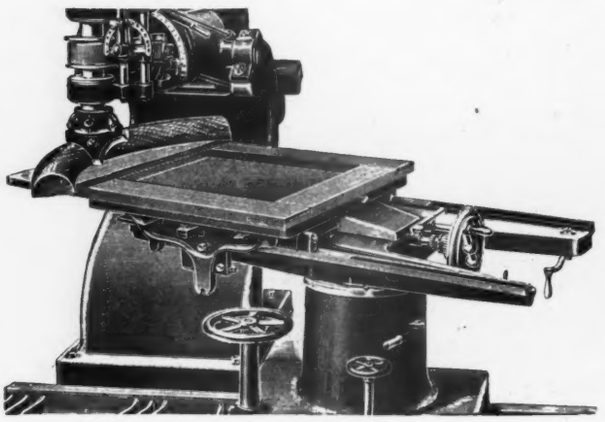


FIG. 5—CUTTING A PATTERN TO A RADIUS OF THREE FEET EIGHT INCHES

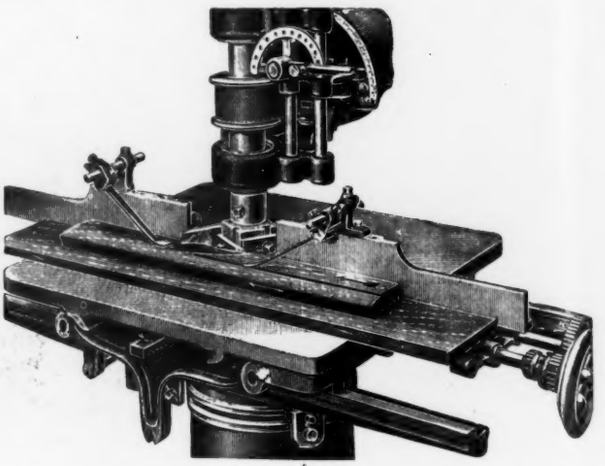


FIG. 6—OPERATING ON HARD WOOD, BEARING SECTION

Large Radius Work.

The machine set for operating on large sectional radius work is shown in Fig. 3. In this view the operator is finishing the inside of a sweep to a radius of 4 feet. The work consists of built-up segments as received from the band saw, and the machine, after being set to the correct radius by traversing the table frame the required distance from the cutter spindle, cleans both the inner and outer surfaces. The cutter head has lips which answer as back irons to the cutter, enabling the cross sections of the wood, always met with in radius work, to be smoothly machined. Sections of any length can be worked, and any radius up to 4 feet can be machined by the radial movement of the table, as shown. For larger radii, a light wooden former, cut from a ½-inch board is all that is necessary. Any depth up to 14 inches can be machined, and by slightly canting the machine head any draw or taper can be given to the work.

In Fig. 4 the wood-working machine is shown operating on radius work similar to that illustrated in Fig. 3, but in this case it has a radius of only 9 inches. A small auxiliary table is used which turns on a pivot pin and is provided with a series of stops, and can be used for circular work of every description up to 18 inches radius. The work can be finished on both sides, and any desired draw or taper can be given. As in Fig. 3, a lipped cutter head is used, and any depth up to 12 inches can be machined.

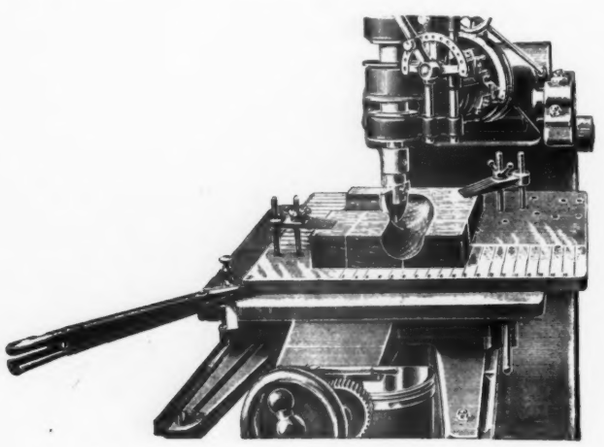


FIG. 7—OPERATING ON SMALL CORE BOX WORK

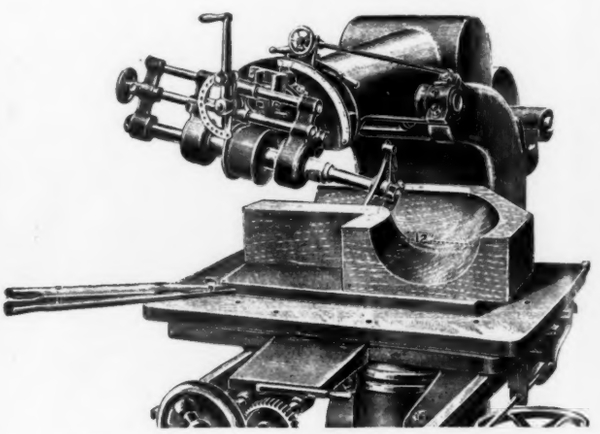


FIG. 8—OPERATING ON LARGE CORE BOX WORK, 12 INCHES IN DIAMETER

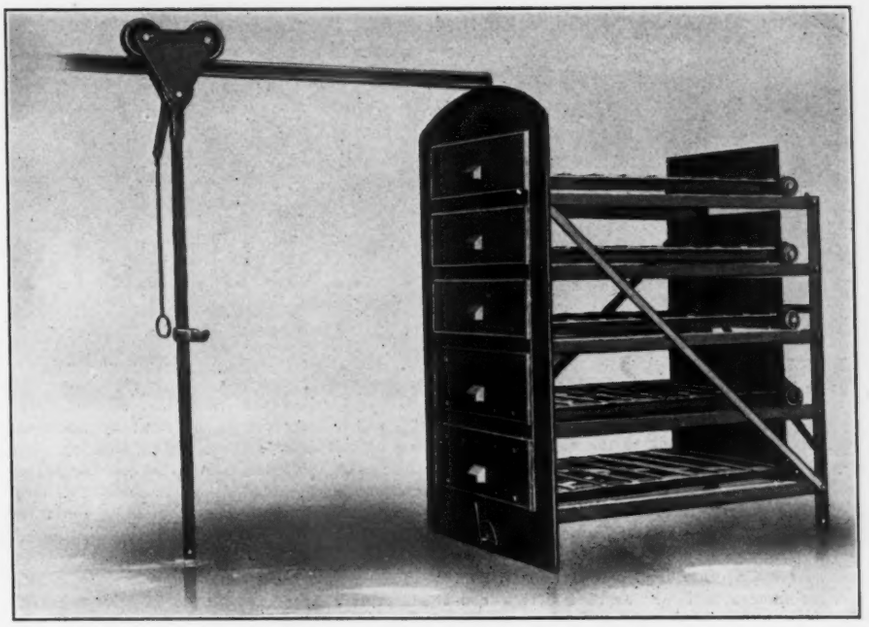
In Fig. 5 the machine is shown cutting a pattern of 5-inch section to a radius of 3 feet 8 inches. The pattern is first cut roughly to shape on the band saw, and the machine is set to the correct radius by traversing the table frame the required distance from the cutter spindle. By the simple radial movement of the table the work is cut smoothly and absolutely accurate. Sections of any length can be machined and any radius up to 4 feet can be worked by the radial movement of the machine. For larger radii a light wooden former is used.

In Fig. 6 the wood working machine is shown operating on lignum vitae bearing sections. In this instance it is used as an ordinary spindle molder. The cutters are made of special, high grade steel for cutting exceedingly hard wood and are mounted on a square cutter block. The feed is by hand and there are numerous operations of a similar character which can be performed on this machine.

Fig. 7 illustrates the machine operating on small core box work, the bend having a 5-inch radius. The auxiliary table on which the work is fixed is used for all similar operations up to a radius of 18 inches. This table turns on a pivot pin and is fitted with stops to regulate the length of bend to be cut. The top of this auxiliary table is machine scribed in inches at right angles from a common center. To set the work for cutting, all that is necessary is to carry the square lines from which the radius is struck down to corresponding lines on the table and to clamp the work as shown. The table is then moved sideways until the cutter spindle is in its correct relation to the cut, and the work is completed by turning the auxiliary table around on the pivot pin to the stops as fixed, running out the straight sections of the box as required, and feeding the cutter into the work by drawing over the lever arm. A fine screw adjustment is provided for regulating the finishing cut when necessary. A simple form of fly cutter is used with which core boxes up to 6½ inches can be cut.

The machine, operating on a core box having a diameter of 12 inches is shown in Fig. 8. In this operation the same movements of the table apply as on the smaller work shown in Fig. 7. The head, however, is deflected and canted to a suitable angle. The cutter head shown, is used for core boxes from 7 to 14 inches in diameter.

This machine is made by Wadkin & Co., Evington Engineering Works, Leicester, England, and is sold by the Oliver Machinery Co., Grand Rapids.



FRAME OF DRAWER TYPE CORE OVEN WITHOUT BRICK-WORK IN PLACE

DRAWER TYPE CORE OVEN.

The frame-work and drawers of a drawer type core oven without the brick-work in place, built by the Whiting Foundry Equipment Co., Harvey, Ill., is shown in the accompanying illustration. The frame-work is self-contained and consists of a cast iron front and structural steel members rigidly bolted together. The drawers are supported at the rear with flanged wheels and are provided with lugs on their front ends which engage a latch on the lifting device attached to an overhead trolley. The wheels are provided with roller bearings and operate on tracks which form a part of the oven frame-work. In operation, the latch on the trolley-lifting device engages the lug on the drawer front and the lever is moved until the drawer is suspended by the trolley when it may be easily withdrawn. A plate at the end of the drawer closes the opening into the core oven when the drawer is fully withdrawn. The furnace fronts, doors and grate are made a standard size and from two to six of these ovens may be installed in batteries fired from one furnace. The distribution of heat in each section is regulated by dampers. The fronts are arranged for five drawers, each 34 inches wide and 60 inches long. The length may be changed by 6-inch sections to suit requirements.

OSBORN "SIVQUICK" RIDDLE.

The "Sivquick" riddle shown in the accompanying illustrations, manufactured by the Osborn Mfg. Co., Cleveland, embodies several novel features of construction intended to increase output, as well as the life of the tool. As shown in the cross section, Fig. 2, instead of attaching the wire cloth in the usual way, around the bottom circumference of the riddle, it is drawn into basket shape and hung over the top of the riddle, the sides of the wire cloth hanging free from the sides of the riddle shield. This patented construction has its principal advantage in the fact that it increases the amount of sifting area without increasing the size of the riddle and entirely eliminates the clogging of the sand around the inside edge. The clinging of the moist sand to the rim causes the wire to rust and this, together with the constant knocking of the

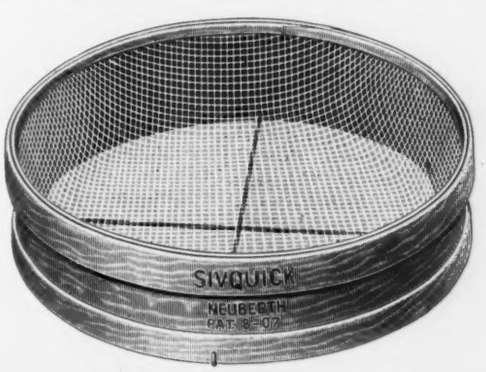


FIG. 1—THE "SIVQUICK" RIDDLE

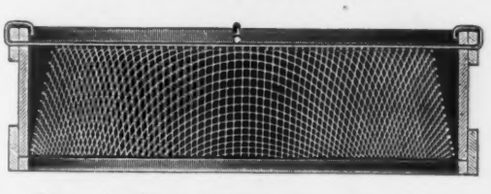


FIG. 2—CROSS-SECTION OF THE "SIVQUICK" RIDDLE

riddle on the flask, soon breaks the wire cloth. By this construction, the inside of the basket is always clean, the sand shakes through freely and cannot clog around the bottom edge. Nor is it necessary to use scraps of iron or gaggers in the riddle to facilitate the sifting of the sand. The riddle is protected with an extra batten at the bottom and top to withstand severe use. It is especially well adapted for use with power shakers and greatly increases the output. The wire basket is made of full weight, foundry grade, galvanized cloth, and is protected at the bottom with two heavy copper wires placed at right angles.

GENERAL INDUSTRIAL NOTES

The Globe Malleable Iron Co., Syracuse, N. Y., will extend its foundry by the erection of an addition 100 x 125 feet, at the north end which will be used for an annealing room, sorting and shipping departments, and an addition on the south end of the same size will greatly increase the molding floor. An addition on the east end of the shop 180 x 25 feet, will be used for a core room and the experimental department. A Bury air compressor has already been purchased from the Bury Compressor Co., Erie, Pa., and several General Electric motors will be installed. This concern is now in the market for air hoists and jib cranes of 1 and 2-tons capacity, and an overhead, electric conveyor system. When these additions are completed the buildings will cover about two acres.

The Maxwell-Briscoe Motor Co., Tarrytown, N. Y., is planning to erect a brass foundry.

The Vancouver Pipe & Foundry Co. will erect a large foundry in the southern part of Hastings townsite, B. C. The proposed building will be 150 x 75 feet.

The Weatherly Foundry & Machine Co., Weatherly, Pa., is planning to add a steel foundry. The capital stock of this concern was recently increased from $50,000 to $100,000.

A brass foundry and additional repair shops will be erected by the Illinois Traction System at Champaign, Ill.

The main foundry building which will be erected by the Central Foundry Co. at Anniston, Ala., will be 120 x 520 feet.

The Wyatt Mfg. Co., Salina, Kans., will erect a new building, 50 x 120 feet, two stories high, the lower floor of which will be used for offices and a foundry and the second floor for a pattern shop.

The Ruston Foundry & Machine Shops, Ltd., Ruston, La., will erect a new foundry which will have a capacity of about 100 car wheels daily, together with five tons of gray iron castings. The equipment, which has not yet been purchased, will include a cupola, motors, air hoists, tumbling mills, etc.

The Bay View Foundry Co., Sandusky, O., is adding a brass foundry which will be operated in connection with its gray iron plant.

The Miller Pasteurizing Machine Co., Canton, O., manufacturer of sterilizing machinery is installing a brass foundry for the production of brass castings used in the construction of its machines.

The Hardwick-Abbott Mfg. Co., Dallas, Tex., will add a brass foundry to its gray iron department and machine shop. This concern is a consolidation of the Greenville Foundry & Machine Co., Greenville, Texas, and the Machinery Mfg. Co., Dallas, Texas.

The United Metal Mfg. Co., 525 West Twenty-sixth street, New York City, has added a brass foundry, which is now in operation. Owing to insurance requirements the furnaces are operated with gas instead of oil as first contemplated.

The Federal Brass Co., recently organized at Elkhart, Ind., has removed to 319 Hydraulic avenue, South Bend, Ind., and has equipped its shop with Steele-Harvey Brass melting furnaces.

The Commonwealth Steel Co., Granite City, Ill., will further extend its plant by the erection of two new buildings. The finishing shop will be 75 x 125 feet and the core shop and sand storage building, 62 x 112 feet. The new equipment purchased consists of a 7½-ton traveling crane, one 4-foot planer, as well as a 10-foot, heavy duty planer.

The Pennsylvania Steel Co., Steelton, Pa., will erect a large extension to its steel foundry.

The Chicago Hardware & Foundry Co. has awarded a contract for the erection of a new gray iron foundry at North Chicago, Ill. The building will be 100 x 220 feet.

The Penn Foundry Co., York, Pa., will erect a new foundry at the junction of Carlisle avenue and the Pennsylvania tracks.

The Central Foundry Co., Anniston, Ala., has definitely decided to rebuild its pipe foundry recently destroyed by fire. It was erroneously reported that this concern would transfer the equipment of the burned plant from Anniston to Holt, Ala., where it is building a pipe foundry near its blast furnace.

The Nelson Valve Co., Chestnut Hill, Philadelphia, will erect a new plant, consisting of 10 buildings of reinforced concrete construction. The brass foundry will be 48 x 256 feet, finishing shop 48 x 256 feet, iron machine shop 48 x 176 feet, storage and office building 48 x 216 feet, assembling room 64 x 90 feet, pattern shop 48 x 48 feet, pattern storage vault 48 x 80 feet, addition to iron foundry 50 x 64 feet, and chemical and testing laboratory, 32 x 35 feet.

The La Crosse Plow Co., La Crosse, Wis., is contemplating the erection of a foundry, 80 x 300 feet.

The Hyde Park Foundry & Machine Co., Hyde Park, Pa., is erecting a new machine shop, 50 x 100 feet, with a 25-foot lean-to, and as soon as the machine tool installation can be completed the foundry floor space will be greatly increased, inasmuch as a number of machine tools are now located there. This concern manufactures chilled and sand rolls, ingot molds, etc.

The Bucyrus Co., South Milwaukee, Wis., is erecting an addition to its foundry, 75 x 130 feet.

The new foundry which will be erected by the Oklahoma Iron Works, Tulsa, Okla., will be 80 x 160 feet.

The Gerlinger Steel Casting Co., West Allis, Wis., is erecting an addition to its plant, 28 x 60 feet.

August Jeske, Milwaukee, Wis., will erect a new brass foundry on Cawker Place.

The Western Crucible Steel Casting Co., Minneapolis, has purchased additional land adjoining its plant, upon which extensions will be erected in the near future.

The Chester Steel Casting Co., Chester, Pa., will erect a new plant, 100 x 150 feet, in which a side-blow converter will be installed.

The Industrial Works, Bay City, Mich., will install a 10-ton open-hearth furnace designed by Carr & Spear, New York City.

The Frontier Iron Works, Buffalo, will erect a new plant consisting of five buildings, having the following dimensions: 90 x 240 feet, 40 x 125 feet, 60 x 100 feet, 28 x 120 feet, and a brass foundry, 40 feet square.

The United Iron Works Co. has decided to add to its Iola, Mo. works, a large brass foundry for the production of brass and aluminum castings.

The Lundin Steel Casting Co., Chelsea, Mass., has begun the erection of a new steel foundry at Neponset, Mass., near the Pope Hill railroad station. The building will be 50 x 100 feet. While this concern is engaged in the manufacture of crucible steel castings, plans have been prepared for the installation of a small open-hearth furnace. The foundry at Chelsea will be operated after the completion of the new plant, to take care of local trade.

The Moline Plow Co. will erect a new foundry at Stoughton, Ill., for the Mandt Wagon Co., a subsidiary of the Moline concern. The new plant will be 80 x 208 feet, and it will be devoted entirely to the manufacture of gray iron castings for agricultural implements.

The Idaho National Harvester Co., Moscow, Idaho, has commenced the erection of a new plant, which will include a foundry 40 x 61 feet, machine shop 36 x 100 feet, wood working and assembling shop 40 x 100 feet, paint shop 40 x 90 feet, and an office building, 25 x 40 feet.

The Interstate Pattern Co., Cleveland, has been organized by F. W. Fretter and A. G. T. Smith. Mr. Fretter was formerly with the Bruce-Meriam-Abbott Co., and Mr. Smith was formerly manager of the Great Lakes Pattern Co. The shop of this concern is located at 5122 St. Clair avenue.

The Empire Foundry Co., New Brunswick, N. J., is replacing its pattern shop, which was recently destroyed by fire, and is also installing modern cleaning machinery, having purchased exhaust tumbling barrels from the W. W. Sly Mfg. Co., Cleveland.

The Detroit Radiator Co., Detroit, now occupying temporary quarters, expects to build a new plant, site for which has not yet been selected. It will be located in or near Detroit.

The Flather Foundry Co., Nashua, N. H., has made extensive improvements to its plant. An additional cupola of about eight tons capacity has been installed, together with a 10-ton Whiting jib crane.

The name of the Comstock Brass Foundry Co., Cleveland, has been changed to the National Bronze & Aluminum Foundry Co. C. W. Comstock has severed his connection with this concern and is now president of a company engaged in a similar line in Akron. He has been succeeded as secretary and manager by J. H. Shafner, who was formerly connected with the Allyne Brass Co.